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1. **Nursing Procedures in the Acute, Convalescent and Chronic Stages of Poliomyelitis.**
2. **Therapeutic Applications of Hot Packs.**
3. **The Use of the Respirator and Nursing Care in the Respirator. The Advantage of the Positive Pressure Dome.**
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5. **Physical Therapy and Occupational Therapy Procedures in the Acute, Convalescent and Chronic Stages of Poliomyelitis.**
6. **Bracing Procedures.**
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Moderator and Chairman: Herman J. Bearzy, M.D.

1. The Diagnosis and Treatment of Acute Bulbar and Bulbospinal Poliomyelitis: by Warren E. Wheeler, M.D., Professor of Pediatrics, Ohio State University, Columbus, Ohio.

2. Physical Medicine and Rehabilitation in the Treatment of Poliomyelitis: by Gordon M. Martin, M.D. Section, on Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, Minnesota.

3. The Correct Psychological Attitude Toward Severe Paralytic Poliomyelitis: by Kenneth D. Arn, M.D., Internist, Dayton, Ohio.

4. Progress in Research Pointing to the Eventual Control of Poliomyelitis: by Hart E. Van Riper, M.D., Medical Director, The National Foundation For Infantile Paralysis, New York, N. Y.

5. Question and Answer Period.

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1. Any subject of interest or pertaining to the field of physical medicine and rehabilitation may be submitted.

2. Manuscripts **must be** in the office of the American Congress of Physical Medicine and Rehabilitation, 30 N. Michigan Ave., Chicago 2, not later than June 1, 1953.

3. Contributions will be accepted from medical students, internes, residents, graduate students in the pre-clinical sciences, and graduate students in physical medicine and rehabilitation.

4. The essay must not have been published previously.

5. The American Congress of Physical Medicine and Rehabilitation shall have the exclusive right to publish the winning essay in its official journal, the ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION.

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7. The winner shall receive a cash award of $200, a gold medal properly engraved, a certificate of award and an invitation to present the contribution at the 31st Annual Session of the American Congress of Physical Medicine and Rehabilitation at the Palmer House, Chicago, August 31 through September 4, 1953.

8. The winner shall be determined by the Annual Awards Committee composed of four members of the American Congress of Physical Medicine and Rehabilitation.

9. All manuscripts will be returned as soon as possible after the name of the winner is announced.

10. The American Congress of Physical Medicine and Rehabilitation reserves the right to make no award if, in the judgment of the Annual Awards Committee, no contribution is acceptable. The Congress may also award certificates of merit to contributors whose essays may be considered second and third best submitted. Announcement of the winner will be made before August 1, 1953. Officers and members of the American Congress and the American Society of Physical Medicine and Rehabilitation are not eligible for this award.

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1. Pollock in Svien, H. J., and Dodge, H. W., Jr.: Peripheral Nerve Injuries, GP 5:57 (March) 1952.

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RESEARCH METHODOLOGY*

K. S. LION, PH.D.**
CAMBRIDGE, MASSACHUSETTS

I

In a period when science becomes a matter of public interest and newspaper material, when research projects of many million dollars are set up comprising an amassment of manpower into thousands of research workers, when particle accelerators of formerly unheard of dimensions, and electronic computers requiring tens of thousands of electron tubes are built, it becomes necessary at times to pause and to consider the impact of such a development upon research, its meaning and aims, its purpose and methods. Such a reflection involves considerable difficulties. A scientist's judgment of what constitutes "real research" is highly subjective and is only too easily influenced by the research worker's own attitude, education, and temperament; and an objective measure of what constitutes basic progress can be arrived at only over a period of years, sometimes exceeding the lifetime of a scientist. Medical libraries are crowded with research papers which, at the time of their publication, were considered to be of great scientific importance, and which years later had only some historical significance or not even that. Yet, the difficulty of arriving at a proper judgment must not deter us from trying our best to give an answer to the meaning of the present development and the purpose of research. In fact, a knowledge of what constitutes progress in research today is not only of academic interest; it is of fundamental, practical importance. It will help us to determine the best direction research should follow, and the way in which it is to be best carried out.

The impulses that lead to a man's scientific activity are many — the goal is generally only one: "to find out something." Applied to the natural sciences this "something" usually means the structure or the behavior of a natural object or the rules and laws that govern a natural phenomenon or a natural process. In this respect science of today is not different from that of a hundred years ago, and it never will be. However, the description of a natural law or a natural process can be given in a variety of terms. The more fundamental and elementary the concepts used in the description, the more basic will be the understanding and the knowledge obtained from the discovery. Here is the point where modern science deviates distinctly from the older practice. The basic sciences, physics and chemistry, have undergone a revolutionary development during the past decades, culminating in the formulation of natural laws of the most general validity, in the development of the most basic concepts, and in the discovery of the elementary particles of matter. These concepts are new, more elementary and more fundamental; they will therefore permit us to state a natural law in more basic terms and with a more general meaning than ever before. The advantages are obvious. Without the use of a basic description or without systematics and the logical skeleton of a science, every single phenomenon demands a special explanation. In contrast herewith, on the basis of a logical science, every single phenomenon can be explained by a *limited* or *small number* of *general laws*. Where such an explanation has not yet been furnished, we can be reasonably sure that it will be furished one day by the same laws. The impact of this philosophy has fundamentally influenced Physics and Chemistry. It is safe to predict that the result will be of equal revolutionary impact upon the biological sciences. This development will permit us to use the more general micro-structural and statistical concepts where the macroscopic and continuity concepts used in the past were inadequate. For instance, the concepts

*Read at the Thirtieth Annual Session of the American Congress of Physical Medicine, Instruction Seminar, New York, N. Y., August 28, 1952.

**Associate Professor of Applied Biophysics, Department of Biology, Massachusetts Institute of Technology, Cambridge, Mass.

of electric conductivity or of dielectric constant are of a macroscopic nature; applied to the microstructure of a nerve or of a membrane they lose their significance. A description of an electrical conduction process in such media seems to be much more adequate in terms of energy levels of electrons and work functions. Similarly, it is very likely that the process of muscle contraction or of action potential propagation will never be satisfactorily explained without the concepts of quantum mechanics.

These examples have not been chosen to scare the reader with the heavy armament of theoretical physics, but rather because in these examples the use of basic physical concepts seems indispensable for a satisfactory solution. Of course, we are aware that in the fields of biological and medical research there is still ample space for work on a "classical" base. Even so, any research work in these fields seem to represent a more valuable contribution *the more it uses the elementary concepts of* PHYSICS AND CHEMISTRY.

II

The need for an explanation in terms of basic physical concepts makes it mandatory for any experimental research work that deals with physical phenomena to use physical research methods. This may sound obvious, but such is not always the case. As an example, we mention the mitogenetic radiation: a radiation of a physical nature apparently emitted from some biological objects. The radiation is invisible and its existence has never been proved beyond doubt with physical methods. However, the radiation stimulates mitosis in other biological objects brought into the vicinity of the emitter which can thus be used as detectors. This kind of a detection is, of course, open to criticism. The situation would be vastly different if a physical measurement would permit the determination of the physical nature and of the energy of the emitted radiation, so that the radiation process could be correlated with chemical processes going on in the emitting substrate.

The example is of twofold interest; it not only shows the great superiority of measurements in physical terms and magnitudes (which would open the way to a much more thorough understanding and interpretation), but the example also introduces the peculiar difficulties of physical measuring methods. There are, of course, quite a number of sensitive measuring methods available that permit the indication of the smallest amount of radiation that can possibly be emitted, namely of a single quantum. However, the smaller the amount of such quanta, the larger is the expected statistical error, and also is the influence of external disturbances or of unavoidable natural fluctuation within the measuring instrument. These disturbances are called noise, and any magnitude to be detected or measured, with an accuracy of say 5 per cent, must exceed the noise level by a factor of 100:5, i.e. by a factor of 20. The effort of the research worker, therefore is directed to the designing of his experiment in such a way as to make the signal-to-noise ratio as large as possible. Unfortunately, this is not so simple or obvious that any research worker, for instance one with an education in experimental physiology, could dream up an appropriate instrument. Yet, the influence of noise upon the result is of considerable practical importance: for instance, in the measurement of action potentials, in myography, electroencephalography, in measurements of ocular sensitivity and many other magnitudes. This requires familiarity with the field of instrumentation and the basic laws that determine the operation and the effect, the ultimate resolving power and the natural limits of research methods.

All these things are by no means new. For instance, the natural limit of the resolving power of a microscope has long been a favorite examination topic in premedical physics, but the practical importance of these and other fundamental problems in instrumentation has become more acute through the development of new electronic methods, instruments and instrument systems. It used to be possible to "see through" a simple experimental setup without the use of analytical

methods. This possibility does not exist any more in an extended system of the type used today in many physical, biological and biophysical investigations, and it so happens that at the present time a new science comes into existence, whose object is the study of instruments and research methods.

Examination of an older physics text will show Newton's laws side by side with the cathetometer, the Wheatstone bridge or the method for the measurement of optical brightness. Modern physics texts show a tendency to break away from this tradition, and to emphasize a more theoretical treatment of physics. The measuring method and the instrument are treated only where they serve to clarify the physical concept, such as energy, wavelength, free mean path. This does not mean that the knowledge of instruments and methods is less significant than it used to be; it seems rather that the reverse is true: an ever increasing number of students, after leaving the universities, go into experimental and developmental careers, not only in the fields of biology and medicine, but likewise in fields such as physics, engineering sciences, chemistry, drug and food technology, aeronautics, textiles and many others. The need for comprehensive education in the field of instrumentation and methodology is very considerable. In fact we have observed over a period of many years that the more research minded a man is, the more he expresses a need for a comprehensive knowledge in instrumentation and methodology.

If one follows the development a little closer, one will find that the field we are talking about has broken away from physics and is becoming a separate field and a science in itself. Looked upon with contempt at times during its infancy (and sharing this fate with most other sciences in their infancies) it has grown, not only out of necessity, as a service course, not as an accumulation of techniques and tricks, but out of the recognition that it has the character and the attraction of any science, and that it incorporates the elements and the logical structure of a science.

A few words concerning the terminology used may help to clarify the purpose and extent of this science. The word *Instrumentation* is most frequently used, but it may be misleading and refer to the rather technical aspect of the field. The word *Methodology* seems to be much more adequate; it places the emphasis correctly upon the essentials, namely the method, which is permanent, rather than upon the instrument which usually undergoes changes. The word methodology was originally introduced in the philosophical system of logic by Kant and refers to that part which proves the logical justification of the methods to obtain information in the different branches of science. The widening of this concept to include the methods used to obtain information by experiment in the natural sciences seems logical and permissible. Other names have been proposed such as *Instrumentology* (Klopsteg), *Metrology* or *Metronomy*. Whatever the ultimate nomenclature will be matters very little; the field is centrally well defined as the science that deals with the physical means and instruments to obtain information. Of course, at the periphery this definition is vague and rather inadequate, as in most other fields of science.

III

It is not the intention to furnish here an outline of the entire field of methodology, but it may be of interest to discuss some representative trends in the present development of instrumentation, in particular with respect to their possible application in medical research. One of the most widely advertised developments is that of computers, electronic and otherwise. There are two different types of computers, the digital and the analogue computer. The digital computer is best described as a desk calculator. It is an adding or subtracting machine, and can, by repeated action, perform multiplications, divisions, and other computations. The usual motor driven gear arrangement is frequently replaced by electronic means, with the result that computations can be carried out at a speed many orders of magnitudes higher than were

possible with the old desk calculator. This high speed makes it possible to compute entire series of curves or functions within fractions of a second. The information is usually fed into the machine by punched cards or punched tape. The original information or any result or interim result can frequently be stored within the machine, and picked up at a later time in the calculation process. These storing devices have obtained some notoriety under the name of "memory systems." As an example of such a system we mention a magnetic one: A core of some ferrous material is arranged within a coil. If a current pulse is sent through the coil, the core will become magnetized, the direction of polarity depending upon the current pulse passing through the coil. The core, therefore, "remembers" the pulse direction, and this information can be picked up by a suitable element. If the information is no longer needed, an alternating current is sent through the surrounding coil which demagnetizes the core, so that it is ready for the storage of new information. It is obvious that for extensive computations involving many figures a great number of tubes and storing devices is needed.

Different from the digital computers, and probably of much greater interest in medical research is the analogue computer. Such a computer is primarily a "simulating system," which may be explained by the following example: Assume that we are interested in the study of a nerve-muscle preparation and that we would like to know more about the influence of a circulating system which either furnishes new nutrient solution or carries away waste products. Assume further that we would like to change the different parameters involved in this process, such as rate of flow, metabolic rate, etc., and determine their influence upon this process; we then have a fairly complicated system before us. Of course, one could vary one parameter at a time and determine its influence by chemical analyses in every step, but such a procedure would be enormously time consuming and would require considerable effort and expense before we arrive at a picture of the entire process. It would be far simpler if the magnitude we are interested in, for instance the concentration of a certain constituent of the metabolic product, could be indicated directly on a meter, or if the variation of this concentration with rate of flow could be viewed on the screen of a cathode ray tube, or plotted on a graph with a coordinate recorder. In some cases it may well be possible to build an experimental setup of the described type, but in most cases such a procedure would be too complicated or expensive and might not warrant the effort. Another alternative would be the use of mathematical analysis, but here again new difficulties may appear. It may be very difficult or even impossible either to set up an equation or to find numerical values to insert into the equation, or the solution of the equation may be time consuming or altogether impossible. Here then is the point where an analogue computer may offer some help, this means that it may be profitable to build a model, preferably of an electrical nature, in which the single components imitate and thus characterize the single biological steps involved in the phenomenon under investigation. For instance, the production and accumulation of a metabolic product may be replaced by a voltage charging a capacitor, while the action of the circulatory system may be presented in such a model by a resistor which discharges the capacitor or by a voltage source with opposite polarity which has the same effect. If such a model is set up intelligently, it becomes relatively simple to vary the different parameters by hand or automatically, and to observe the effect of every one of them on an electric indicator. By further modifying the model one can approach the reality to any desired degree. Analogue computers of this type have been used to visualize processes like the propagation of nerve action potentials (O. H. Schmitt) or thermal processes within organisms, or in radiation therapy. They have helped in problems of physiological acoustics and theory of hearing; they can be used in problems of ergometry and muscular fatigue. They

represent auxiliary methods, similar to other mathematical or physical methods which permit clarification of the entire investigation and reduce the number of experiments needed.

The methods of analogue computation have been particularly successful through the use of electronic methods which permit fairly accurate addition, subtraction, multiplication, division, integration and differentiation, and the generation of almost any type of mathematical functions. This is one reason why electronics has found wider application in medical and biological research than before. Besides, the use in computers, the present trend is towards the development of electronic research methods using pulses and pulse techniques. It is possible now to count pulses occurring at a rate of several millions per second, and not only to count them, but to sort them according to size or width, or frequency. Of particular interest in this respect is the development of discriminators and gate circuits which will pass only pulses of a predetermined size, while smaller, as well as larger pulses are rejected. Such instruments may prove to be most useful in the field of electro-myography.

The electronic amplifier is still the instrument of greatest interest and of widest use in medical research and practice. Through the use of appropriate feedback circuits it has become possible to increase the stability of amplifiers so that measurements at highest sensitivity, i.e. smallest input voltage of several microvolts only, can be made with considerable accuracy. There are some features, which may not be particularly new, but which have been technically improved to such an extent that an electronic amplifier can be applied where unsurmountable difficulties formerly excluded them. One of the main difficulties in studying any kind of electric phenomena in man has always been the presence of disturbing potentials, for instance line voltages. Through the use of differential amplifiers one has tried to cancel these parasitic potentials, and methods have been developed which permit measurement of a desired potential, even in the presence of a disturbing, so called "in-phase" potential exceeding the desired potential by a factor of more than 50,000. However, the method has certain limitations concerning the grounding of the amplifier or the patient. With a new method this difficulty is also eliminated. The biological potential to be measured is applied to a small radio frequency oscillator, modulating the transmitted message. The receiver and amplifier are locally and electrically separated from the subject, and the grounding difficulty is thus overcome.

The high vacuum-heated cathode electron tube has found a competitor in the grid controlled crystal, the transistor. Such a transistor usually consists in a germanium single crystal which, by appropriate chemical and thermal treatment, has a region in which a surplus of electrons exists, and another region where there is a surplus of positive charges (or a lack of electrons). If an electric field is applied, the electrons tend to move and cause a current, whereby the magnitude of current can be controlled by the potential applied to a barrier layer between both regions.

The transistor has a number of valuable advantages, such as extremely small size, no required heating source, and minute supply voltage requirement, all of which may be of advantage in cases where an entire amplifier has to be used within a living organism. Such applications may be rare at the present time, but there may arise a need for them in times to come. On the other hand the transistor furnishes only a small output power, and most undesirable for many biological research methods is the fact that the transistor has a low input impedance and, therefore, draws considerable current from the object under investigation.

Of particular value in the field of biology is the one electronic instrument which has just the opposite character. The cathode follower, because of its very high input impedance, has become a most valuable instrument, in particular when the problem is concerned with the measurement of potentials occurring in single nerve fibers or membranes.

It may be worthwhile here to make a statement concerning the input impedance of electronic circuits. It is correct that input impedances in the order of magnitude of many megohms can be obtained, up to about 10^{15} ohms or even higher. But this input impedance is not constant and varies with the applied voltage. When it is necessary to measure over a wide range of input voltages, the older string electrometers, for instance the Lindemann electrometer, still offer input impedances several orders of magnitude higher than can be obtained with electronic instruments. It seems sometimes that these older instruments such as the electrometer or galvanometers have been forgotten or are considered outmoded. Such an opinion is, of course, not always justified. The galvanometer is still the instrument with the highest available voltage sensitivity, and where its low input impedance and its slow response can be tolerated, it offers the decided advantage of stability and accuracy, besides the above-mentioned sensitivity. The development in electronics has not been without influence upon the development in the field of galvanometry, and by the use of appropriate feedback systems it is possible today to use galvanometers with an effective input impedance of many megohms. Also the period and the damping of galvanometers has been improved and made variable through the use of electronic means and circuits.

A particularly interesting development has taken place during the last few years (and still is taking place) in the field of transducers. A transducer is considered to be any element of instrumentation which converts a nonelectric physical phenomenon into an electrical one or vice versa. A photoelectric cell, for instance, changes physical radiation into electrical voltages or currents and is, therefore, an "active" transducer, while a fluorescent tube, an incandescent bulb, or an X-ray tube acts as passive transducer, converting electric energy into radiation. These transducers on many occasions have been the weakest link in research instruments, but lately a great amount of research activity has helped to improve the well known older methods and to create new ones. A few examples from the field of mechanic-electric transducers may help to illustrate this development. Mechanical displacements are frequently used as indications of other magnitudes of interest in some investigations. Pressure variations, for instance, may cause a mechanical displacement of a membrane. Also volume variations, thermal expansions or contractions, liquid or gaseous flow, variations in density of gases or liquids, the position of a needle in the groove of a phonograph record, or such biological phenomena as heart activity or ballistocardiac activity, blood flow or muscular action may all cause the displacement of a mechanical member. In a few cases the measurement may be made directly by observation of this displacement; but in other cases the movement is so small that electrical amplification is required, or electric circuits are used to modify the output in other ways, such as for integration, discrimination, filtering, sorting, etc. In order to feed the primary information, i.e. the mechanical displacement into an electric system, it is necessary, therefore, to convert it into an electric magnitude, either in a voltage, or a current, or a resistance variation or in any other way. The great variety of methods available for this purpose is a clear indication that the solution of this problem is not very simple. If the displacement is large and the mechanical force available is sufficiently great, the displacement can be made to cause a variable resistance or potentiometer to move; but this method, while relatively simple, frequently causes a variation in steps, instead of a continuous resistance variation, and is likely to also introduce contact noise. The resistance strain gauge is sometimes applied, but the relative variations in this gauge are small and considerable electronic means are needed for the conversion, detection and measuring of the signal. Also the resistance strain gauge (and so also the electrolytic transducer based upon the variation of the electric pathway in an electrolyte) is very sensitive to temperature variations. An entirely dif-

ferent group of transducer tries to solve the problem with electromagnetic inductors, either by varying the air gap, or by changing the magnetic properties of the core (magnetoelastic or reluctance variation method). [The mechanical force connected with the displacement must be large, of course, compared to the electromagnetic forces acting in the magnetic circuits.] The requirements for the subsequent electrical circuits are usually severe. A third group makes use of the variation of capacitance between two electrodes, and since the electrostatic forces in the capacitor are generally much smaller than the electromagnetic ones in the inductor, the capacitor method lends itself to the measurement of displacements where only very small forces are available. The requirement to enable the subsequent electric circuits to pick up the capacitance variation is at least as severe as for the inductance method, sometimes even more so. A particularly simple new method is available where large forces or pressures, but only small displacements, are available. Transducers made from Barium titanate and operating on piezoelectric principles have been developed lately and offer a very promising method for the measurement of forces and mechanical pressures.

Perhaps the most important, and certainly the most interesting trend in methodology, is the part that deals with certain analogies in complex systems. These systems can be of a physical nature, for instance an apparatus, a circuit, or a network; or they can be of a biological nature, such as a cell, an organ, or a body; but a system can also be understood in a more general sense and can be an organism, a structure, a society, etc. The important point is that in all these systems an agent acts at the input, and a response is created at the output of this system, in accordance with the system characteristics. It is now of considerable interest to show that under certain conditions very general rules can be found that govern the behavior of all such equivalent systems. The mathematical treatment of all such equivalent systems is in general identical, even though the physical or physiological interpretation can be very different. One can see immediately that the problems in system research are easily accessible to analogue computation. The application of "system research" to biological problems has found notoriety under the name Cybernetics (Wiener), a very promising new science which is likely to furnish, from the investigation of simple response characteristics, information as to the type of the investigated system and to its operating principles. It is perhaps not exaggeration to say that Physical Medicine in the future will gain its greatest benefit from such system investigations. For instance, in the problems of muscle rehabilitation we have a complex system before us showing some very typical response characteristics which reoccur in every equivalent case with considerable regularity. It is beyond any doubt that the system is very complex; it involves physiological as well as psychological factors, and one cannot expect to understand the connection of the single processes and linkages at the present time. But it is very probable that system research in the near future will give us some information as to the *type* of a system we have to deal with, and to the number and kind of elements and feedback loops that are involved. Once we succeed in understanding the entire system, it may well be possible to separate or isolate experimentally the single elements involved, and to study, with physical methods, the elements themselves under normal and pathological conditions. Such research seems to be of a much more fundamental nature because it considers the partial effect of every element involved in the process under investigation, i.e. the contribution of the physical, chemical, physiological and psychological factors involved in a complex process.

We have tried to give a short account of the present trends in the field of research methodology. We hope to have shown that research, either in the field of medicine or in the field of methodology involves not the building of equipment or the design of instruments, or the process of making measurements, not even of making better diagnoses or ther-

apies, but that good research is concerned primarily with the finding of the laws and rules that govern the behavior of a natural phenomenon. We frequently see accumulations of experimental data obtained with considerable expense and manpower. Such data can be valuable, but sometimes they represent more material that can be reasonably understood and analyzed, and the invested effort is frequently wasted. Where this is not the case, where research is carried out with the knowledge that its supreme goal is understanding and descriptions in terms of elementary units and magnitudes, it will profit through the use of the modern science of research methodology.

Rehabilitation Of The Hard Of Hearing*

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In 1951 there were approximately 10,000,000 people in the United States who were hard of hearing to some extent in one or both ears but only about 4,000,000 were believed to have serious handicaps. Approximately 100,000 people in the United States were totally deaf. In the same year, 20,000 deaf children were being educated in 75 public residential schools, 178 public day schools and 48 denominational and private schools for the deaf in the United States. Approximately 1,000,000 children in public schools were hard of hearing but not sufficiently handicapped to require hearing aids or lip reading. It was conservatively estimated that about 1,000,000 hard of hearing in the United States wore hearing aids. Thus there are approximately 3,000,000 hard of hearing having a serious handicapping loss who do not use hearing aids but should. Some 5,000 people have had the fenestration operation.

There is a difference between the term "hard of hearing" and the "deaf." The word "deaf" is used in the modern dictionaries, unfortunately, to designate both the hard of hearing individuals and those people who are totally unable to hear. In otological circles, the term "hard of hearing" means that a person has difficulty in hearing the spoken word. A deaf person on the other hand cannot hear at all, or if he does, can hear only loud noises such as near-by explosions. He may hear, but cannot understand words shouted at the ear. The deaf person does not have usable hearing which will enable him to receive and carry out instructions by the spoken word. The most satisfactory method of rehabilitating a deaf person is by lip reading. Sign language is used to some extent but in general lip reading is preferred.

At the present time the rehabilitation of the hard of hearing can be accomplished by: 1. Surgical operation; 2. The proper selection of a hearing aid; 3. Lip reading or communication by observing the movement of the lips, mouth and throat muscles together with other signs and gestures.

The surgical method will not be discussed in this paper. Suffice it to say that anyone desiring information on this subject should consult a qualified otologist, who will make an otological examination, employing an audiometer, a device for measuring the acuity of hearing, and will determine whether the patient's type of deafness is amenable to the fenestration operation. As implied, a window is made through the bony wall of the middle ear into the horizontal semicircular canal by a delicate surgical operation.

As mankind uncovers the secrets of physics and engineering the knowledge is applied to the rehabilitation of the injured. At one time, rehabilitating the hard of hearing comprised use of a tube, horn or sign language. The speaking tube was a means by which the sound from the speaker was concentrated and directed to the deafened ear. Such an in-

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strument was highly efficient and still is; but for obvious reasons it was inconvenient and could not be used until both persons were set for conversation. The horn was said to gather the sound and concentrate it at the ear.

Since the time of Galileo, some 300 years ago, lenses have been ground and have been used to rehabilitate the visual acuity of the eye. The modern hearing aid is not more than fifty years old. The electrical hearing aid is the result of the invention of the telephone, but significant progress was accomplished only following the introduction of the electronic technique into its design. The modern electronic hearing aid is an instrument of notable technical development and with all its shortcomings is still considered a far reaching achievement.

The hearing aid is used largely for rehabilitating the hard of hearing. Most hearing aids are supplied through hearing aid salesmen or agents for some hearing aid manufacturer, of which there are fifty or more in the United States; twenty-six manufacturers of hearing aids have instruments on the accepted list of the Council on Physical Medicine and Rehabilitation. Of recent development are centers or clinics which are manned by qualified persons able to make a systematic examination of the hearing of an individual and to suggest the type of hearing aid by a trial method which might help.

A rehabilitation facility for the hard of hearing is known by several names but usually they are called "hearing clinics" or "hearing centers." The otologist prefers the name "hearing center" and deprecates the term "hearing clinic." These facilities offer testing, educational and rehabilitational services for children and adults but are not engaged in the sale or servicing of hearing aids or their accessories. The facility is distinguished from the general practice of otolaryngology because of its emphasis on the audiological testing, social, educational and economic problems of the hard of hearing individual.

According to the evidence in the office of the Council on Physical Medicine and Rehabilitation there are 117 facilities in the United States that offer services from mere advice to the hard of hearing to a very high degree of testing procedures and the selection of hearing aids. These facilities are sponsored** as follows:

Individual	1
Veteran, Army and Navy	3
Public Health	3
Schools and Institutions	7
American Hearing Society	24
Hospitals and Medical Schools	33
Universities and Colleges	56

**Some have overlapping sponsorships.

Although definitive standards have not been set up, the consensus on the subject is that a hearing center or rehabilitation facility for the hard of hearing should meet the following requirements:

(1) It should have equipment for evaluating the hearing from a prosthetic point of view and means to determine the advisability or feasibility of a hearing aid.

(2) It should be capable of determining whether a hearing aid will be satisfactory and to give selective evaluation of the amplification required.

(3) It should afford physical quarters sufficiently commodius for the tests to be undertaken.

(4) It should provide a special room, such as a sound-conditioned chamber, or location for supplying the quiet environment which is necessary for making the test.

(5) It should maintain a stock of hearing aids with which the tests are carried out for selecting a hearing aid.

(6) It should have ways and means of following up the patient.

(7) It should provide medical services or should have a set policy of obtaining otological diagnosis and adhering to medical recommendations in advance of making final recommendations regarding the hearing aids. Generally speaking, a facility should not process a case before receiving a report of a recent examination by a qualified otologist (it is relevant to state that this ideal medical cooperation is not achieved at the present time but efforts are being made to accomplish this close cooperation.)

(8) The facility should maintain a schedule of fees for the services it offers in connection with hearing aid selection. This schedule should be a reasonable one.

(9) It should not engage in the sale of hearaids or accessories.

(10) The facility may offer the service of making impressions for ear molds and make arrangements with a local company for manufacturing the ear pieces.

(11) It should have a high degree of ethical relations with the medical profession, patients and hearing aid purveyors.

The personnel engaged in hearing aid selection and rehabilitation of the hard of hearing might well also satisfy the following requirement: The supervisor of the program shall have a certificate in audiology (the science of sound as referred to hearing). A knowledge of the physics of sound (acoustics); how

to operate the audiometer and other hearing testing equipment; of the rudiments of lip reading and instructions on how to teach the hard of hearing to understand and to operate a hearing aid and on the limitations of the instrument.

Recently a national board for the certification of hearing aid salesmen has been established by a division of the International Hearing Aid Association. The particular organization that has charge of the certification program is called the Society of Hearing Aid Audiologists. This is an industrial organization, and the dealers are attempting to improve their relationship with the patients and physicians as well as to raise the educational standards in the field. It is an effort on the part of the industry to lift itself by its own bootstraps.

In the opinion of the medical profession, this program is a step in the right direction, because any self-regulating organization within a highly competitive industry is welcomed by all, especially the physicians. There are a number of criticisms of the program which will have to be dealt with. The important one is on the term "audiology." This term means the science of sound in the field of hearing. It is a word which is used by highly trained individuals, those who have taken post graduate work in college of the Ph. D. level. Professional men of the doctoral level (Ph. D. or M.D.) look with disfavor upon the hearing aid salesmen taking over the word audiologist and applying it to a group of people who have not gone through such a rigorous training. Ways and means are being surveyed at the present time to find another name. Other avenues of criticism revolve around the amount of training to be given to the applicants for the Board of Certification.

This program has a long road ahead and at present it is not approved or disapproved by members of the medical profession. They have taken a "wait and see" attitude.

The hearing aid is basically a miniature public address system. It consists of a microphone, a vacuum tube amplifier, and an earphone, tantamount to a small loudspeaker and fitted tightly into the ear.

The hearing aid industry is a highly competitive one. It is not too difficult for an enterprising man who is qualified in electronics to manufacture hearing aids. The unit is small and the cost of handling components cannot be compared with that of a heavy industry. The device itself is an asssembled instrument. Practically all of the microphones are purchased from one supplier, namely, the Brush Development Company of Cleveland; most of the vacuum tubes are purchased from one supplier, namely, the Raytheon Manufacturing Company of Waltham, Massachusetts. Other components are purchased from the various suppliers, and the manufacture of the hearing aid becomes a production line problem. The distribution is a serious undertaking, and herein lie the difficulties with which a hearing aid manufacturer is confronted. Because of the competition and the reluctance of the hard of hearing individuals to do anything about their hearing, manufacturers claim it is difficult to sell the products. Thus, we find considerable lay advertising appearing in the public press and frequently find exaggerated or misleading statements made in order to attract the hesitant hard of hearing person who is embarrassed by his condition. This is one of the reasons why such misleading and unwarranted claims as "hidden hearing," "hear in secret," and "nothing in the ear" have appeared in advertising. The Council on Physical Medicine and Rehabilitation objects to such claims.

In conclusion it is pointed out that the hard of hearing may be rehabilitated by the three following methods: (1) surgical operation; (2) proper selection of a hearing aid; and (3) lip reading.

Centers are being established for the examination and rehabilitation of the hard of hearing. In these facilities the hard of hearing are given instructions (1) on the use of hearing aids and (2) on lip reading as a means of communication. The reading of lips supplements the hearing aid. Otological examinations are not given except when a physician

is in attendance, but the amount of hearing loss in degree of disability is determined.

Most of the hearing aids at the present time are supplied through hearing aid dealers. The distributors of hearing aids are striving to establish an association which will improve relations with the patient and the physician and also elevate the educational requirements of the hearing aid purveyors. The same organization is establishing a board of certification for the hearing aid salesmen.

Discussion

Dr. C. O. Molander (Chicago): Mr. Carter has given a fine review of some of the highlights in the field of rehabilitation of the hard of hearing. He points out the difference between the deaf and the hard of hearing. In this paper Mr. Carter is concerned with the hard of hearing. He outlines rehabilitation procedures under: 1. surgical—the fenestration operation which should be done only by a highly skilled otologist; 2. lip reading communication, which is recommended for the deaf; and 3. proper selection of a hearing aid.

The Council on Physical Medicine and Rehabilitation lists 117 public and private hearing centers which offer services from mere advice to the hard of hearing to a very high degree of testing procedures and the selection of hearing aids. A model set-up is described. This set-up emphasizes the point that patients should be referred to these centers by otologists. The supervisor of this type of center should have a certificate in audiology.

In line with the foregoing, the hearing aid manufacturers have organized a Society of Hearing Aid Audiologists, with a Board of Certification. The purpose of this organization is to raise the ethical standards of the industry.

In comparing the two set-ups, several questions come to mind: 1. Are the supervisors of the first set-up trained in universities? 2. Will members of the second set-up organize hearing centers with a sales office attached? 3. Will not these two set-ups compete with each other for business? 4. Is there not a similarity between these two set-ups and the oculist and optometrist?

Clinical Applications of Ultrasonic Energy in Treatment of Acute and Chronic Subacromial Bursitis*

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Physical therapy in the form of radiant heat, hot moist packs, long and short wave diathermy, microthermy and electrotherapy, has long been a recognized form of treatment for the acute case of subacromial bursitis. Roentgen therapy has been accepted as one of the efficacious forms of treatment when physical therapy or drug therapy fails to alleviate the acute pain of this condition. Steinburg and Roodenburg[1] recently reported on the use of corticotropin (ACTH) in the treatment of acute subacromial bursitis, and it is their belief that this agent is more effective than roentgen radiation as a form of therapy.

The introduction of ultrasonic energy as a form of medical therapy and its application to different diseases has been a controversial subject among American and European clinicians. In the past few years investigation of ultrasonics stepped into the foreground of medical interest and has stimulated an increasing number of publications on this subject. Despite the volume of favorable literature that has come from the European clinicians and investigators, a critical review of their reports leaves one skeptical as to the reliability and scientific accuracy of many of the claims made. Certainly the reported clinical results of ultrasound therapy in some forty-eight different diseases should not be unconditionally accepted. Neither should this form of therapy be condemned or discarded until more fundamental biological studies and clinical evaluations can be made by American clinicians and investigators. It is with such a purpose therefore, that we have attempted to evaluate ultrasonic energy in the treatment of acute subacromial bursitis and to present our observations and experiences even though limited in the number of patients.

Basic Principles of Ultrasonics

Ultrasound therapy is a form of physical therapy based on the application of energy produced by sound waves of a frequency between 800 to 1000 kilocycles per second. The production of sound waves of this frequency is based on the piezoelectric principle discovered by P. Curie in 1880. According to this principle, quartz crystals and certain other crystals can be electrically charged on opposite surfaces when they are subjected to mechanical pressure. Similarly, if such quartz crystals are exposed to a high frequency alternating electric field, they will oscillate according to their natural frequency. It is by means of a piezoelectric transducer or crystal that the electrical field is transformed into ultrasonic vibrations. These vibrations, representing the ultrasonic energy, are then transmitted to the front plate of the treatment head.

Ultrasonic waves are unable to penetrate air layers even as thin as one hundredth of a millimeter because the transmission of sound depends upon the density of the medium transversed. Since quartz is 1000 times more dense than air there is virtually no transfer of ultrasound from the treatment head through the air. Consequently, in order to convey this energy from the treatment head to the area to be treated, a coupling medium is required which will eliminate any air layers and will establish uninterrupted sound contact. Liquid paraffin, vaseline, castor oil, or water free of air

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are the most widely used coupling media for the transmission of ultrasonic energy to the patient.

Treatment Technique

This study employed two different ultrasonic generators: the Piezo-Vibrator with the frequency of 1000 kilocycles per second and a capacity of .25 to 5 watt output through a one centimeter crystal; and the Birtcher experimental model with a frequency of 1000 kilocycles, a capacity of 0.5 watts to 24.5 watts per centimeter square (W/cm^2) through a seven centimeter crystal.

Ultrasonic energy was administered to the involved shoulder by direct contact between the treatment head and skin, using mineral oil as the coupling agent. The transducer or treatment head was moved in a slow, circular, gliding motion, keeping constant contact with the skin over the involved area (fig. 1.)

Fig. 1—Direct application of the transducer to the involved shoulder using mineral oil as the coupling agent.

Low intensity therapeutic doses of 2 to 4 watts per centimeter square ($2\text{-}4^w cm^2$) were applied for a maximum time of five minutes. Treatments were given daily for three consecutive days and then three times per week to those patients requiring more than three treatments.

Report of Cases

Case 1.—B.T., a 49 year old white female complained of extreme pain and tenderness in her right shoulder for three days. There was no history of trauma or exposure. The pain permitted no sleep at night. Physical examination revealed a moderately severe tenderness over the right subacromial bursa and a 50 per cent loss of motion in all ranges. Roentgenograms were negative. After three consecutive ultrasonic treatments of 2 watts for five minutes for each treatment, patient had complete relief of all symptoms and a full range of motion. She was followed for two months with no evidence of recurrence.

Case 2.—D.L., a 53 year old white male was referred to the Department of Physical Medicine and Rehabilitation because of marked pain and tenderness in the right shoulder. Acute onset of two days' duration followed a day of heavy work in the garden. Examination revealed severe tenderness over the right subacromial bursa and a 90 per cent loss of motion through all ranges. Patient stated that he had used an electric pad over the shoulder and had taken many aspirins in an endeavor to relieve pain. Roentgenograms were normal. The patient was given seven treatments, using three watts for five minutes for each treatment. He reported that the pain had subsided about 50 per cent and that he could move his arm about 40 per cent better. There was complete relief of all pain and tenderness after six treatments and full range of motion after seven treatments. No evidence of recurrence.

Discussion

During the period from June 1951 to April 1952, fifty patients were treated for clinically diagnosed subacromial bursitis with ultrasonic therapy. An analysis of table 1 shows that there were twenty-six males and twenty-four females ranging in age from 21 to 70, with an average age of 46. The right shoulder was involved in thirty-three patients; the left in sixteen and both shoulders in one patient. Forty-three patients were diagnosed as having an acute bursitis and seven as having an acute exacerbation of a chronic bursitis. In each instance the chief complaint was pain, tenderness and limitation of motion of from two days to one year duration. Seventeen patients had received various forms of physical therapy including shortwave diathermy, microthermy, and roentgentherapy. A total of 293 ultrasonic treatments were given with an average of 4.9 treatments necessary to obtain relief of pain and tenderness and a normal range of motion. Thirty-two patients (or 64 per cent) reported marked improvement of their symptoms and a full range of motion; five patients (or 10 per cent) had moderate improvement of pain and tenderness and a full range of motion; two patients were listed as having only a minimal amount of relief of pain and tenderness and no increase in the range of motion; eleven patients (or 22 per cent) had no improvement either in pain and tenderness or range of motion.

Table I — Summary of Fifty Cases of Acute Subacromial Bursitis Treated with Ultrasonic Therapy.

Case	Sex	Age	Shoulder	Limit Range Motion	Pain Tenderness*	Onset	W/CM² Dosage	Days R'x	Improvement Marked	Mod	Min	None
BT	F	49	R	50%	+3	3 da.	2W/5min.	3	X			
DL	M	53	R	90%	+3	2 da.	3W/5min.	7	X			
RD	M	58	R	50%	+3	3 da.	3W/5min.	6		X		
CG	M	60	R	40%	+4	6 mo.	4W/5min.	6				X
DD	M	59	L	50%	+3	3 da.	2W2½min.	4	X			
MD	M	46	R-L	60%	+4	4 da.	2W/3min.	1	X			
BC	M	53	R	60%	+3	2 da.	2W/3min.	3	X			
McG	M	25	R	60%	+2	2 wk.	3W/5min.	3	X			
HW	M	70	R	10%	+3	2 da.	3W/5min.	6	X			
BN	F	31	R	10%	+2	8 mo.	4W/5min.	10				X
SJ	M	60	R	20%	+2	4 mo.	4W/5min.	10				X
HH	F	24	L	10%	+2	3 mo.	3W/5min.	6	X			
SV	M	38	L	20%	+2	1 wk.	2½W/3min.	8	X			
SL	F	38	L	40%	+2	1 wk.	3W/3min.	3	X			
KM	F	51	R	10%	+2	3 mo.	3W/3min.	8				X
AJ	F	44	R	40%	+3	3 wk.	2W/3min.	10			X	
FE	M	49	R	40%	+3	1 wk.	2W/5min.	6	X			
SD	M	54	L	20%	+2	8 wk.	3W/5min.	8				X
ABH	M	55	L	80%	+2	6 mo.	4W/5min.	10				X
BP	M	57	R	10%	+2	2 yr.	3W/5min.	8		X		
MC	M	34	R	90%	+3	2 da.	2W/3min.	7	X			
KE	M	33	R	80%	+3	2 da.	2W/5min.	6		X		
GB	M	26	R	60%	+2	3 da.	3W/5min.	3	X			
LB	F	52	L	80%	+1	8 wk.	3W/3min.	10				X
DU	M	43	R	60%	+3	1 wk.	3W/5min.	4	X			
MB	F	32	L	40%	+4	3 da.	2W/5min.	6	X			
HW	M	70	R	20%	+3	3 da.	2W/5min.	3	X			
SN	F	45	R	50%	+3	4 da.	3W/3min.	1	X			
SE	F	49	R	10%	+2	3 da.	3W/5min.	5	X			
AE	F	67	L	30%	+3	2 da.	3W/5min.	5	X			
BC	F	70	R	15%	+2	3 mo.	3W/5min.	10				X
BL	F	55	R	10%	+2	4 mo.	3W/5min.	10				X
BR	F	41	R	90%	+3	3 da.	2W/5min.	6	X			
SH	F	21	R	70%	+4	3 da.	2W/5min.	2	X			
SR	M	54	R	40%	+2	4 da.	2½W/5min.	4		X		
CL	F	43	L	10%	+3	3 da.	2W/5min.	4	X			
MM	F	36	L	20%	+2	6 mo.	3W/5min.	9				X
AM	F	42	R	30%	+3	1 yr.	4W/5min.	10				X
GV	M	52	R	50%	+3	3 da.	2½W/5min.	4	X			
CR	F	68	R	10%	+3	2 mo.	3W/5min.	10		X		
FR	M	62	R	80%	+4	3 da.	2W/5min.	4	X			
NR	M	60	L	70%	+2	1 wk.	3W/5min.	3	X			
SM	M	42	R	60%	+3	3 da.	2W/5min.	4	X			
HS	F	28	L	70%	+3	6 da.	2W/5min.	6	X			
HB	M	42	R	60%	+3	3 da.	2W/5min.	4	X			
ES	F	21	R	70%	+4	4 da.	2W/5min.	6	X			
EM	M	64	L	20%	+2	3 mo.	4W/5min.	12			X	
DD	M	45	L	50%	+4	2 da.	2W/5min.	3	X			
ES	F	28	R	70%	+4	2 da.	2W/5min.	4	X			
EV	F	32	R	80%	+3	3 da.	2½W/5min.	2	X			

* *GRADING*
+ 1 — Mild
+ 2 — Moderate
+ 3 — Moderately Severe
+ 4 — Severe

It is significant to note that of the 64 per cent reporting marked improvement, all had been treated within one to seven days after the acute onset of pain. At the same time all the cases reporting no benefit from the ultrasonic treatments were seen within a period of between eight weeks to one year after the acute onset of pain and tenderness.

Summary

This investigation of ultrasonics was concerned with the clinical and practical application of a new form of therapy for

the painful shoulder caused by a subacromial bursitis. The aim was to evaluate the effectiveness of this type of therapy in alleviating the pain and tenderness and to estimate the time and dosage necessary to accomplish this. From the data collected, the following facts can be stated:

I — With low intensity doses, ultrasonic therapy is effective in relieving the pain and tenderness of an acute subacromial bursitis.

II — Ultrasonic therapy seems to be of little value in the treatment of chronic cases of subacromial bursitis.

III — Ultrasonic therapy can be considered safe if applied within the limits of low intensity therapeutic doses.

IV — Simplicity of application and the short duration of each treatment are an advantage to the busy practitioner and patient.

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SERUM NEURITIS
Analysis of Sixteen Cases*

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Serum sickness is a well-recognized complication of the use of therapeutic sera, particularly horse serum. The characteristic manifestations are urticaria, lymphadenopathy, fever, and arthralgia, which usually spontaneously disappear after a few days of discomfort without important after-effects. Very infrequently a painful, long-lasting and disabling neuritis may occur as a complication of serum disease. Although this condition is well recognized in the medical literature, papers dealing with the subject usually consist of only one-to-five case reports with a review of the literature. The purpose of this presentation is to analyze 16 cases examined by the author during the past seven years and to describe in detail some unusual features in two patients.

All 16 patients were male, 15 of them ranging in age from 16 to 37, the sixteenth being a 65-year-old surgeon. Fifteen had received tetanus antitoxin because of an injury, usually an occupational accident, the surgeon, for instance, having cut his finger while removing a plaster cast. One patient had received serum for meningitis. In every instance the neuritis was confined to one or both upper extremities. In five cases the involvement was bilateral; but all unilateral paralysis occurred on the right, regardless of the site of injection. The distribution of muscular weakness was as follows: serratus anterior, 12; supra- and infraspinatus, 11; deltoid, 9; and the flexor pollicis longus, 3. The trapezius, subscapularis, latissimus dorsi, teres major, biceps, triceps, and pronator teres muscles were each affected twice in this series, and the extensor digitorum communis, extensor carpi ulnaris, flexor carpi radialis, flexor digitorum profundus I and II, opponens pollicis, abductor pollicis brevis, lumbricales I and II, and abuductor minimi digiti, once. If one considers the roots responsible for innervation of the above muscles, the frequency of involvement coincides with that most commonly found in the literature. Forty-seven muscles were supplied by C_5, 36 by C_6, 21 by C_7, 12 by C_8, and two by C_4. (See table 1.)

Table 1 — Root Distribution

	Muscles Involved	Per cent
C_4	2	2
C_5	47	40
C_6	36	30
C_7	21	18
C_8	12	10

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The usual clinical course is that of the onset of serum sickness three-to-ten days after the injection. This is manifested by a fever of 2-5 degrees Fahrenheit, generalized aching of muscles and joints, urticarial rash of varying degrees, usually associated with generalized lymphadenopathy. Signs and symptoms of neuritis classically appear from a few hours to a few days after the serum sickness. Pain in one or both shoulders develops and may become excruciating, requiring opiates. One patient has been reported in the literature who became psychotic because of the severity of the pain.[1] The discomfort usually subsides gradually in the course of several weeks, but a patient not included in this series was seen by the author in the psychiatric section of the hospital because of pain that had persisted for a year from the onset of the neuritis. Weakness appears in the muscles affected within a few hours or days, and is followed later by atrophy if degeneration of the peripheral nerve occurs as indicated by the changes in electrical excitability. Objective sensory changes are not striking, being confined to minor hypesthesia in the dermatomes of the roots involved.

The following case is reported in more detail, as the sequence of events was quite unusual:

J. B., a 27-year-old carpenter's helper, suffered a puncture wound of his left foot at work. He received immediate treatment, including injection of tetanus antitoxin in his left arm, after tests for sensitivity were found negative. The following day he had some muscular aches and pains persisting for two days, and on the third and fourth days after the injection he had a fever ranging from 102 to 104 degrees Fahrenheit associated with some lymphadenopathy. On the sixth day he had pain in his right shoulder, followed by some numbness in the terrain of the axillary nerve and weakness of abduction. The pain and lymphadenopathy gradually subsided, and by the thirteenth day his only complaint was weakness of the right shoulder. Examination at that time revealed poor grade strength of the right supra- and infraspinati and deltoid muscles, with hypesthesia of the skin in the area innervated by the axillary nerve, and normal electrical excitability of the affected muscles.

On the nineteenth day following injection he developed a giant urticaria and had quite severe joint pains. The rash and arthralgia gradually subsided in the course of 4-5 days without perceptible change in the neurological condition. He did develop a slow response of the deltoid muscle on direct current stimulation, but retained response to a tetanizing current in some of the muscle fibers, being classified as having a partial reaction of degeneration.

He received physical therapy consisting particularly in graded strengthening exercises for the weakened muscles. Strength tests five months after injury revealed maximums of 5 pounds for abduction, 7½ for flexion, and 5 pounds for external rotation, as compared with 15, 17½, and 15 pounds for the same muscle groups on the left. He increased his strength 2½ pounds during the following month when he stopped treatment and returned to work, although he had only about 50 per cent of normal power of the affected muscles.

This case is of interest because of the early occurrence of neuritis and late appearance of serum sickness. The following patient, however, had even more striking and unusual clinical manifestations.

K. S., a 27-year-old linotype operator, received a laceration of his nose while working. The wound was sutured and, after a negative skin test, he was given a routine prophylactic injection of tetanus antitoxin. Twelve hours later he developed some red spots on his skin with itching, and on the fifth day developed urticaria, nausea and vomiting. There was no associated asthma, dyspnea, or difficulty in swallowing, but because of the persistent vomiting he was admitted to the hospital. His temperature was 100.4 degrees Fahrenheit, pulse rate 120 per minute, and respirations normal. He was in considerable distress with obvious hyperactive peristaltic activity of the gastrointestinal tract and diffuse fasciculations of the muscles of the trunk and upper extremities. The lower extremities had residual weakness from a childhood anterior poliomyelitis, with an essentially flail left thigh and leg and only fair-to-good power on the right. The general physical examination was otherwise not remarkable except for slight weakness of the shoulder girdle muscles bilaterally which was related to the present illness. Laboratory studies including blood calcium, phosphorus and phosphatase levels were all normal. The spinal fluid examination revealed no cells and normal chloride, sugar, protein and gold sol determinations. Electromyograms were recorded from the left and right deltoid, biceps, triceps, abdominal, quadriceps, hamstring, anterior tibial, and gastrocnemius muscles. All muscles tested except those in the left leg showed frequent, irregularly occurring diphasic spikes of voltages varying from 10-200 microvolts. These records could not be distinguished from those commonly seen in patients with progressive muscular atrophy or amyotrophic lateral sclerosis. The fasciculations gradually subsided over the course of a week as muscular strength returned to its previous level and intestinal discomfort disappeared. The patient was discharged two weeks after admission with no residual symptoms.

Comment

It has been estimated that only 15 per cent of individuals receiving prophylactic or therapeutic sera, usually horse serum, develop serum sickness. There is no known way of anticipating this event nor any effective prophylaxis, as it occurs in the presence of negative sensitivity tests. We have no accurate knowledge of how frequently the complication of serum neuritis occurs. A review of the literature in 1949[2] reported only 100 cases in the literature. Other reviews have been made by Doyle,[3] Bennett,[4] and Fischer.[5] Serum neuritis is sufficiently uncommon to make it worth while to report small series of cases and a review of the literature for each new generation of graduating medical students, and to emphasize to practicing physicians and surgeons, particularly those in industrial practice, the seriousness of serum neuritis.

The fact that one physician should see 16 cases in seven years suggests that it is more common than realized, and because of the industrial disability it occasions it would seem important that the use of tetanus antitoxin be avoided whenever possible by previous immunization with tetanus toxoid.

The mechanism of production of serum neuritis is still not readily explainable. One may postulate reactive edema and pressure of the roots in the spinal foramina, but only one patient in this series, the 65-year-old surgeon, gave evidence of narrowing of the foramina from osteoarthritic changes. The predominance of right-sided lesions is also a a puzzling finding.

The occurrence of widespread muscular fasciculations is also hard to explain. A second patient in this series also gave a history of fasciculations at the onset of his neuritis but no electromyograms were done. It is of interest that both of these patients had some muscular weakness as a residual of childhood poliomyelitis.

Residual weakness is said to be found in about 20 per cent of cases. In the present series adequate follow-up was not secured; but in 14 cases in which a reaction of degeneration was present, a significant degree of paralysis developed after three months in five cases, and after six months in eight patients, two of whom showed residuals of 12-18 months' duration. Only two patients had definite return to normal power, which occurred in one and three months respectively; and both failed to develop changes in electrical excitability.

Summary

1. This study of 16 cases of serum neuritis indicates that it is a serious hazard complicating occupational accidents, leading to months of disability and perhaps permanent residual weakess of some degree.

2. Quantitative studies of electrical excitability have been found to be of prognostic value in determining the extent and duration of disability.

3. The neuritis most commonly occurs following the use of tetanus antitoxin and has a predilection for the right upper extremity and the muscles supplied by the 5th and 6th cervical roots.

4. Two cases with unusual clinical manifestations have been described. In one the neuritis preceded the serum sickness; in the other, there occurred generalized muscular fasciculations resembling clinically and electromyographically those seen in progressive muscular atrophy. Smooth muscle of the gastrointestinal tract was also involved, but all symptoms subsided without residual within a week.

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Discussion

Dr. Joseph Moldaver (New York): Dr. Watkins' excellent paper describes an interesting syndrome that can result from the therapeutic use of a serum.

The syndrome is characterized, first of all, by an intense and excruciating pain, by paresthesia and hypesthesia. In addition to the sensory disturbances there are lower motor neuron lesions. There is a flaccid paralysis, with atrophy, absence of deep reflexes and the usual abnormal electric changes. The pathological signs are mainly found in the C5 C6 C7 dermatomes and myotomes.

I have seen a few cases resulting from the use of tetanus antitoxin, starting between 8 to 12 days after the injection, and would like to make a few remarks and ask some questions.

We all know what is meant by the word neuritis; by definition it should express an inflammation of a peripheral nerve. Most of the toxins and other pathological agents do not result in actual inflammation of the peripheral nerves but in a true primary degeneration. There is a damage or destruction of the axons and of the nerve sheaths, but there is no trace of an inflammation.

For the past years there has been a tendency to substitute the word peripheral neuropathy or radiculopathy for the word peripheral neuritis or radiculitis. In the case of serum neuropathy or post vaccinal neuropathy, reported in literature, there is no post mortem findings available, it is doubtful that there is a real neuritis. I am wondering whether Dr. Watkins would not also prefer the word neuropathy.

I saw, some years ago, many cases of polyneuropathy due to diphtheria; the paralysis and sensory changes are the result of the exotoxin of the bacteria. The toxin seems to spread up centrally along the nerves of the affected region, and can produce a local paralysis; if the focus is in the throat, the initial paralysis is in the palate; if the focus is in the skin, there may be a local paralysis of the affected region. The toxin is also carried in the blood stream and the paralysis can spread in the arms and legs and give a polyneuropathy. I mention it, only because the onset of the paralysis is also about 8 or 12 days after the injection. When the paralysis starts, the serum is usually discontinued because it is useless for the paralysis and because of the possible additional serum complication.

It is very well known, that some vaccines can also result in a mono- or polyneuropathy. In the Spring of 1949 in New York City, 6,350,000 persons were vaccinated against smallpox. Some cases of postvaccinal neuropathy were reported. I have personally seen seven cases. These patients presented practically the same syndrome as the one described by Dr. Watkins. The incubation period varied between 8 to 12 days. The first sign was also an intense and severe pain in the shoulder and arm, there were some sensory changes and also a flaccid paralysis. The affected segments were mainly C5 C6, on one or both sides.

It is also worth while to mention, a similar syndrome which was described during World War II by the British and seen among the soldiers of the Near East. This has been called "localized neuritis of the shoulder girdle" but was not related to any injection. This might possibly be due to some virus infection. The mechanism of the syndrome described is not known. It is interesting to see that the symptoms can be exactly the same for both post serum and postvaccinal neuropathy. Therefore one could postulate some allergic reaction or some abnormal antigen antibody complications.

31st Annual Session

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Requests for applications for scientific exhibit space in connection with the 31st Annual Session to be held at The Palmer House, Chicago, August 31 through September 4, 1953, are being received. Address all communications to the American Congress of Physical Medicine and Rehabilitation, 30 North Michigan Avenue, Chicago 2, Illinois.

Rehabilitation of The Amputee Patient*

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From earliest time, man has sought a satisfactory substitute when it has become necessary for him to lose an extremity. An early Greek author — Aristophanes, hundreds of years before Christ, has mentioned an actor, and a very capable one, who performed with an artificial leg.[1] Throughout the ages, wars have always intensified the search for a better prosthetic device. This has not been due to the greater numbers of amputations but rather to the great interest in the veteran soldier. As a matter of fact, World War II highlighted the fact that there were actually more amputations among the civilian population than there were among members of the Army, Navy and Air Corps. There were over eighteen thousand amputations in the three services during the four years of war but there were over one hundred and twenty thousand amputations in the civilian population of the United States in those same four years.

Because of the increased interest during wartime, several millions of dollars were spent on research to develop lighter and more mechanically perfect prosthetic devices for the upper and lower extremities. A Prosthetic Research Committee was set up, composed of the finest medical and technical intelligence that was available. As research projects were developed, they were distributed to teams composed of doctors, engineers, limb manufacturers, prosthetic technicians and patients in order that an actual trial of all prosthetic devices could be made under adequate supervision. Some excellent results were produced by these teams.

The Prosthetic Service of the Institute of Physical Medicine and Rehabilitation was established over five years ago as a consultant service. There is no surgery performed by this Service nor do they manufacture lower extremity prostheses. However, in the last few years, they have been making upper extremity prosthetic devices. The Service is interested in the after-care of the stump, the prescription of the prosthesis the patient may need, and the careful training in the use of the prosthetic device after it has been fitted. During the past five years, several hundreds of difficult amputee patients have been seen in the Prosthetic Service.

Dr. Henry Kessler, in his book, "Principles and Practices of Rehabilitation,"[2] has pointed out the five points which must be thoroughly explored for every amputee patient if the patient is to have the advantage of a complete rehabilitation program. These include the following: 1) psychological preparation; 2) selection of site of amputation; 3) after-care of stump; 4) selection of prosthetic device, and 5) training in the use of the prosthetic device. These will be taken up in the order named as carried out by the Prosthetic Service of the Institute.

Psychological Preparation: It is always a tremendous mental, as well as a physical blow, when a patient is told that he must lose a portion of his body. Rarely must amputations be performed as an emergency measure, and, time permitting, the doctor should spend adequate time in the preparation of his patient for the amputation. It has been found helpful to have another amputee visit the patient. Care should be taken to select an amputee who has the same site of amputation as is to be performed on the patient. For instance, you do not send a below-the-knee amputee to visit a prospective above-the-knee amputee, but rather send an above-the knee amputee who is able to walk and work to visit with the prospective above-the-knee amputee patient.

Movies are available through the Vet-

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erans Administration and other governmental agencies which describe the amputee patient at work and play. These can be brought to the hospital room and shown to the patient, if necessary.

Selection of Site: The surgeon, at the time of operation, must, of course, make the final decision as to the site of amputation. Many factors such as the condition of the blood vessels, the blood supply and the amount of healthy tissue available will enter into his decision as to the site and length of stump. This paper presents the sites of election, if available, which have been found to produce better results for our patients from a rehabilitation standpoint. Included in these better results are less trauma to the stump which means less bruising, less breakdown of skin, and ability to wear the prosthesis over a longer period of time; secondly, the greater rapidity with which a patient may learn to make the best use of his prosthesis and, thirdly, the most satisfactory prosthesis. Such a prosthetic device may be lighter, may need less servicing and, perhaps, be less expensive. Again it is pointed out that the final choice of site must remain with the surgeon.

Starting with the lower extremity, for above-the-knee amputation, the mid-thigh amputation allowing approximately ten inches of bone below the the trochanter is preferred. The longer stump such as provided by the Gritti-Stokes amputation has many advocates in this country and has long been used in Canada and England; but experience has proved that this stump is not as satisfactory as the mid-thigh amputation. The two factors which enter into this decision are first, there is more danger of a breakdown with an end-bearing stump, and, second, it takes longer to put on the prosthesis. For the below-the-knee amputation, the site of election is at the junction of the middle and upper one-third of the tibia either with the head of the fibula remaining or removed. If the fibula remains, it should be shorter than the tibia and should be tapered.

The Prosthetic Service at the Institute has found that the Symes amputation, which is done through the malleoli above the ankle joint, does not make a satisfactory stump for the fitting of a prosthesis. Several have been fitted at the Institute, but usually the skin over the stump breaks down under use. Again, it must be realized that this amputation is utilized by many surgeons in this country, but, the Prosthetic Service at the Institute has found through experience that it is not as satisfactory as the junction of the middle and upper one-third of the tibia.

The operations of Lisfranc, Chopart and Pirogoff (amputations through the tarsals) are not satisfactory as far as being able to fit the patient with a satisfactory prosthesis is concerned.[8]

For the upper extremity amputation, above-the-elbow stump should be as long as possible, eight to ten inches of bone below the tip of the acromion being very satisfactory. The longer the stump, the more leverage available for the use of the prosthesis. For below-the-elbow amputation, eight or nine inches below the olecranon will preserve supination and pronation. The Prosthetic Service at the Institute has fitted amputees having a wrist disarticulation with satisfactory prostheses but they are difficult to fit, and, of course, the arm is always longer than the normal arm. As much of the hand should always be saved as possible.

After-Care of the Stump: Traction may be used with mole skin adhesive utilizing a divider bar, pulley and weight until healing has taken place.

In above-the-knee amputation of the lower extremity, if elevation is necessary, it is suggested that the patient be placed prone rather than on his back and the stump elevated by means of a pillow. Patients have come to the Institute with flexion contractures resulting from long continued elevation of above-the-knee stump while the patient was on his back. The flexor muscles are much stronger than the extensors, and flexion contractures can take place very quickly in this position.

Two six inch ace bandages sewed end to end are very satisfactory for shrinkage in above-the-knee stump. This should be

Fig. 1A—Bilateral B/E amputee with very short stumps.

Fig. 2B—Bilateral B/E amputee with very short stumps fitted with prosthesis with 3:1 gear ratio at elbow.

Fig. 3A—Hemipelvectomy.

Fig. 3B—Hemipelvectomy with prosthesis.

tighter at the lower portion of the stump and less tight at the top in order to prepare a conical stump. Ace bandages should be crossed posteriorly to the hip joint to prevent flexion contractures. For below-the-knee stump, leather shrinkers are used very satisfactorily. These should be three to four inches longer than the stump in order to protect the tender end.

Selection of Prosthetic Device: Two rather simple tests are utilized by the Prosthetic Service at the Institute in or-

Fig. 2—Proper bandaging of A/K stumps for shrinkage.

der to decide whether the patient is able to utilize a prosthetic device for walking: 1) is the patient able to swing-through on crutches? and 2) can he climb stairs with crutches and the remaining leg? In the consideration as to whether a prosthesis will be prescribed for this patient, the patient's age, his general condition, and, in the case of the lower extremity amputee, the condition of the remaining extremity from a vascular and musculoskeletal standpoint must be carefully studied. Also, both the vocational and avocational interests of the patient must be considered. For instance, the lawyer, who does little walking in his vocation, certainly can get along with a much lighter leg than the farmer who must have a sturdy prosthesis.

Legs are made of willow-wood, metal and plastic. The Prosthetic Service at the Institute utilizes both the willow-wood and the metal, generally using the willow-wood leg. The upper extremity prostheses are made, at the Institute, of a plastic called, "Selectron."

Training: Last, but certainly not least, we consider training in the use of the prosthesis. The training of the upper extremity amputee is done by the Occupational Therapy Department and the patient is not dismissed until he can carry out the ordinary functions of daily living in a satisfactory manner. Also, the Occupational Therapy Department will set up a job situation comparable to the job to which the patient expects to return in order to test the patient's ability to resume his former employment. Training in the use of the lower extremity prosthesis is done by the Physical Therapy Department and, again, the patient must be able to walk, climb stairs and walk on uneven ground in a satisfactory manner before he can be dismissed.

The illustrations demonstrate some of the difficult problems encountered at the Institute. It has been found that the majority of these patients have been able to make a satisfactory adjustment, take care of their activities of daily living and return to some kind of useful work if the foregoing principles of amputee rehabilitation are followed.

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Discussion

Dr. Keith C. Keeler (Cleveland, Ohio): For a pupil to discuss his former teacher's paper is a sign of the times. Dr. Covalt has done a masterful job of presenting a broad subject in concise form. I should like to emphasize four points made by Dr. Covalt: First, a "rehabilitation team" approach to the amputee patient means an encouraged, normal appearing patient. Because amputees are particularly conscious of anatomical loss, closer consultation between the surgeon, physiatrist, prosthetic engineer, limbmaker, physical therapist and vocational counselor complements the service of any hospital. When the physiatrist is called to see prospective amputees pre-operatively, or when he is called to the operating room to confirm the feasibility of a particular amputation site, as has occurred at University Hospitals in Cleveland, the team has begun to find expression. Leaving the patient at the complete mercy of an artisan is non-physiological and has resulted in mal-fitted, discouraged patients. Consultation is most successful when members of the team are present at the same time, in the same place following collective evaluation of the amputee patient. The type of prosthesis is determined as much by vocational prospectus as by body configuration. Therefore, all members of the team are vitally concerned with limb prescription and training.

The second point of emphasis is that lay-organizations, such as Possibilities Unlimited, a local amputee club in Cleveland, may help the physiatrist and his amputee patients in the psychological adjustment to his disability. Through friendly, indirect contact the physiatrist may also help to steer the activities of these groups, thus avoiding duplication of medical and physical therapy functions in the same community.

Thirdly, Dr. Covalt mentioned hip flexion contractures which complicate proper alignment and contribute to poor postures in above the knee or even below the knee prosthesis. Limb alignment and body posture should be checked not only in the standing position, but also in stance and swing phases of normal walking gait. Attention is called to the fact that in a suction socket, weight of the body is borne through the ischial seat which is medial and posterior to the physiological weight-bearing axis which in the normal leg passes through the head of the femur.

Fourthly, as Dr. Covalt again pointed out, training of the amputee patient in use of the prosthesis fulfills one of the aims of rehabilitation; that is, "the appearance of being normal." Psychological preparation, selection of proper site of the amputation, adequate after-care of the stump, and selection of a satisfactory prosthetic appliance do not guarantee successful wearing of the appliance. As Dr. Covalt indicated, training leads to satisfaction.

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Chicago, August 31 - Sept. 4, 1953

Single Bout Elbow Flexion and Shoulder Flexion Ergography Under Conditions of Exhaustion Testing*

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Purpose of the Study

In the May 1952 issue of the ARCHIVES OF PHYSICAL MEDICINE a report was presented on the precision of single-bout elbow flexion ergography.[1] The following results were obtained: (1) a high degree of precision under conditions of mild to moderate muscular fatigue, whether the test bouts were administered on the same day or one week apart; and (2) some reduction in precision when an exhaustion state was reached. The objectivity coefficient** of ergography when carried to exhaustion was 0.78, which was sufficiently high to render encouragement to the belief that satisfactory precision might eventually be achieved. This study was undertaken to determine essential procedures in this process for both elbow flexion and shoulder flexion movements.

Procedures

In studying the precision with which elbow flexion and shoulder flexion ergography may be applied in exhaustion testing, the following procedures were followed:

1. **The Ergograph**[2]: The instrument used to determine the endurance of the elbow flexor and shoulder flexor muscles was the Kelso-Hellebrandt ergograph.

2. **Testing Position**: The position of the subject was the same for both elbow flexion and shoulder flexion ergography, as follows (fig. 1): supine lying with hips and knees flexed, feet resting on table, and free arm on chest. The center of the joint was located opposite the shaft of the ergograph. At the end of the ergograph lever arm, set for a length of eight inches, an archery arm guard was attached. This guard was firmly strapped to the subject's left arm.

3. **Ergograph Loads**: The amount of ergograph load for each subject was individually derived by taking a definite proportion of the strength of the muscles to be fatigued. For example, if the strength of the elbow flexor muscles was 80 pounds, as tested by cable-tension methods,[3] and one-eighth proportion was desired, ten pounds of weight were placed on the ergograph carriage; if three-eighths proportion was specified, 30 pounds of weight were used.

4. **Testing Procedure**: The cadence for all testing was based on one-second movements, regulated by a metronome: flexion was completed on one count and extension on the next. Stress was placed on accomplishing a smooth, constant movement, which necessitated lowering the load at the same rate it was raised.

5. **Subjects**: The subjects utilized were sixty-four male students at Springfield College, one-half participating in elbow flexion and the other half in shoulder flexion research. A further description of the subjects in terms of median scores is as follows: age, 22 years; weight, 152.7 pounds; height, 69.5 inches; Strength Index, 2981 points; and Physical Fitness Index, 105.1. Somatotypes of the group tended dominantly toward mesomorphy.

Results of the Study

Elbow Flexion Ergography

Testing Competence: The first week of testing was devoted to instructing and training the testers in the techniques of elbow flexion ergography. During the second week, the testers were required to demonstrate competence by testing thirty-two subjects twice and correlating the results. In this process, the test bouts were as follows: two minutes duration, ergographic weight load of one-eighth proportion of each subject's elbow flexion strength, and a rest period between bouts of ten minutes. The correlation between the two tests was 0.95, which corresponds well with the results of similar testing during the preceding year. For the third week, the testers again conducted two bouts under the same conditions as above, except that one-fourth strength proportion was used and thirty minutes rest between bouts was required. The correlation between tests dropped somewhat, in this instance to 0.84.

Exhaustion Testing: It was becoming apparent as the research progressed over a period of three years that consistent results in single-bout ergographic fatigue testing could only be achieved when the

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**Objectivity coefficients represent the degree of repeatability of results obtained in ergographic testing of the same subjects with the tests given by different testers.

SHOULDER FLEXION - FULL MOVEMENT

FIGURE 1

ergograph loads were such as to induce exhaustion in a relatively short time. As a consequence, based on trial of ergograph loads to date, three-eighths proportion of each subject's elbow flexion strength was selected for the exhaustion bouts. In each test, the subject continued to exercise at the prescribed cadence until movement of the forearm became so slight that the ergograph distance meter stopped recording.

During the first week of exhaustion testing, two bouts were administered on the same day with thirty minutes rest intervening. The resultant correlation between the bouts was 0.79. This result was comparable to that of the year before under similar circumstances.

For the last two weeks of the experiment, the exhaustion bouts were conducted on separate days. Two exhaustion bouts were conducted each week, making a total of four such bouts for the two weeks. These results are shown in the table. The inter-correlations between the first bout of the first week (1A) and the others ranged from 0.75 to 0.82, all but one, however, being below 0.80. The correlation between the two bouts conducted on the same day (1A vs. 1B) proved to be as high as those administered on separate days. As time progressed, the correlations increased, all but one being above 0.80 during the second and third weeks. Inasmuch as the muscle-conditioning effect of repeated exhaustion bouts was found to be pronounced and was not taken into account in this situation, the precision results are considered satisfactory.

Intercorrelations Between Single-Bout Elbow Flexion Ergography under Conditions of Exhaustion Testing

Test Bouts*	r	Test Bouts	r
1A vs. 1B**	.79	2A vs. 2B	.84
1A vs. 2A	.76	2A vs. 3A	.75
1A vs. 2B	.75	2A vs. 3B	.82
1A vs. 3A	.82	2B vs. 3A	.85
1A vs. 3B	.75	2B vs. 3B	.84
		3A vs. 3B	.80

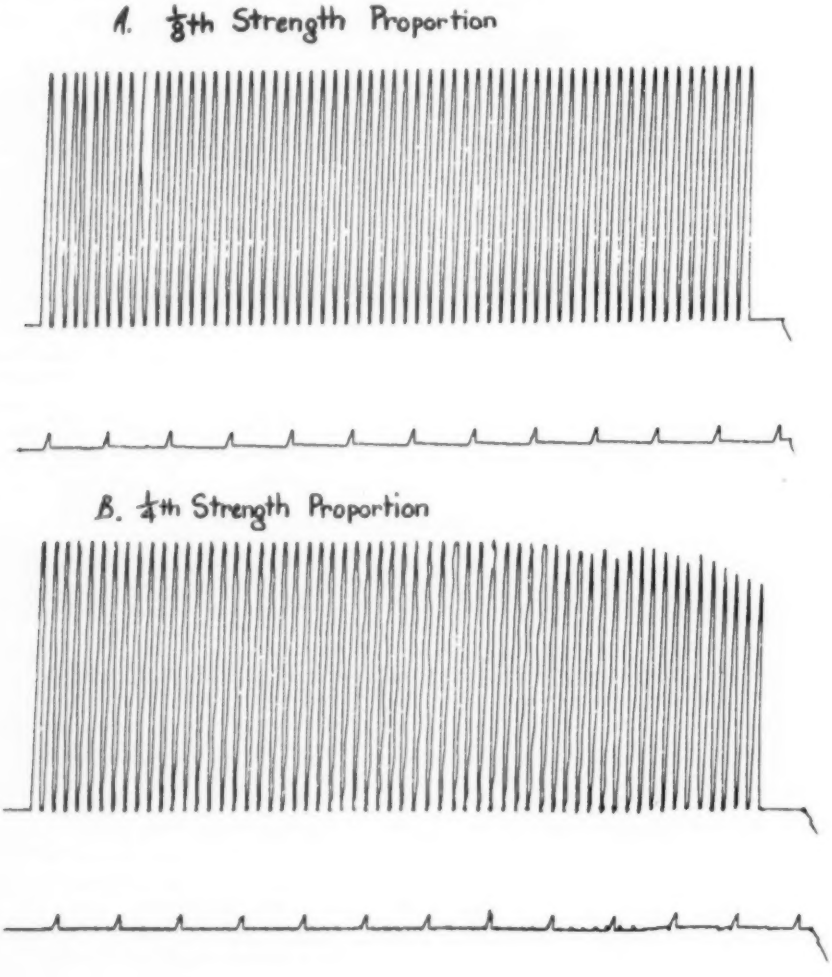
*The numeral designates the week; the letter, the bout each week. Thus, "3B" indicates third week, second bout.

**These two bouts were administered with thirty minutes rest between; for all others, at least 24 hours elapsed.

Kymograph Tracings: The results of elbow flexion ergography under the experimental conditions of this research may be portrayed through kymograph tracings. In figure 2, typical tracings of the two-minute bouts are shown. With weight loads of one-eighth proportion,

the tracings resulted in a true rectangle (fig. 2A). The exercise was not sufficient to induce fatigue to the point of decreased movements of the forearm. With one-fourth proportion, however, some decline in the distance the forearm could be raised was evident at the end of the time period (fig. 2B).

Figure 3 illustrates the effect of ergographic loading when unlimited time bouts were conducted. With weight loads of one-fourth proportion, the subjects continued for an indefinite time. In the illustration (fig. 3A), the bout continued for 4.5 minutes until finally stopped by the tester. The form of the tracing was erratic, with decreases in the amount of forearm movement followed by increases. Consistency between test bouts in this situation was impossible. With three-eighths proportion (fig. 3B), however, a satisfactory curve resulted: the decline in the length of forearm movements was smooth; the amount of time



ELBOW FLEXION KYMOGRAPH TRACINGS - 2 min. TEST BOUTS

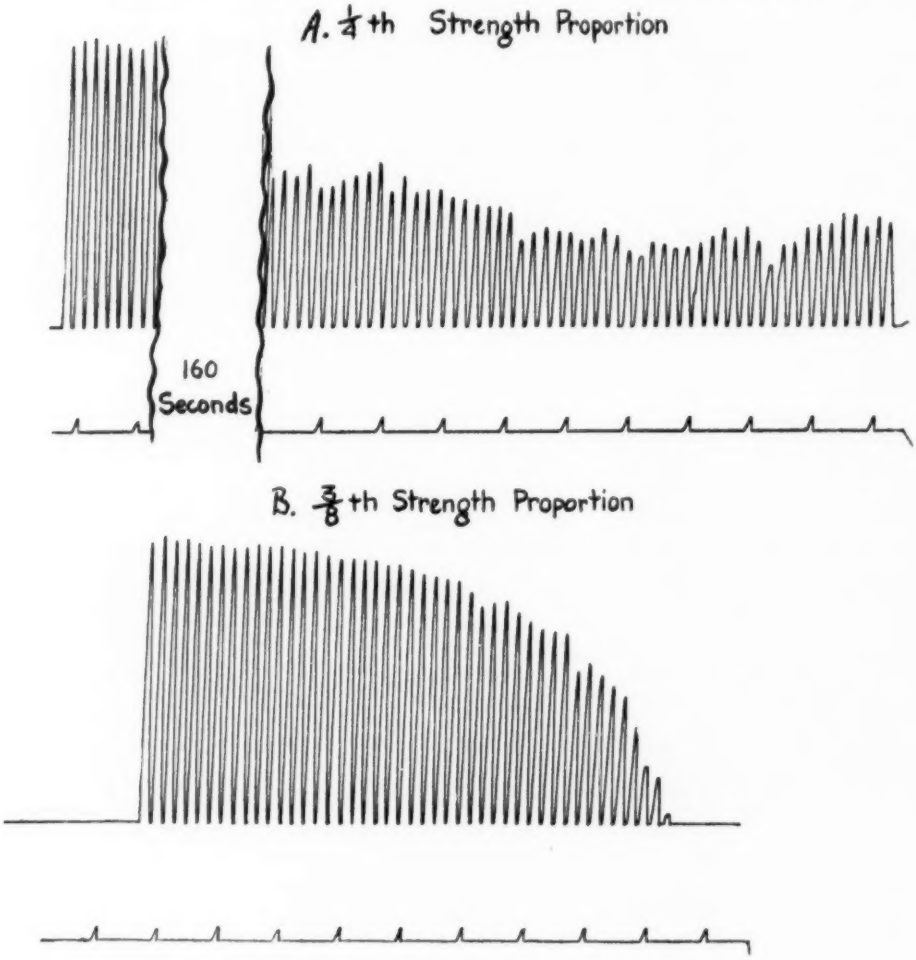
FIGURE 2

to reach exhaustion was relatively short, less than two minutes; and satisfactory consistency from bout to bout was realized.

Shoulder Flexion Ergography

In a previous study,[4] the amount of muscular strength that could be applied at different points throughout the range of motion of various joints of the body was determined. The strongest strength position for elbow flexion was found to be between 100 and 140 degrees, with a decrease in strength of approximately 28 per cent as the forearm was extended to 180 degrees. Thus, as exhaustion is approached during ergographic exercise, the elbow, fully extended, is in a relatively weak position muscularly.

As a consequence of this observation, an investigation was made of the effect upon ergographic testing when the joint is in the strongest strength position at the point of exhaustion. The shoulder flex-



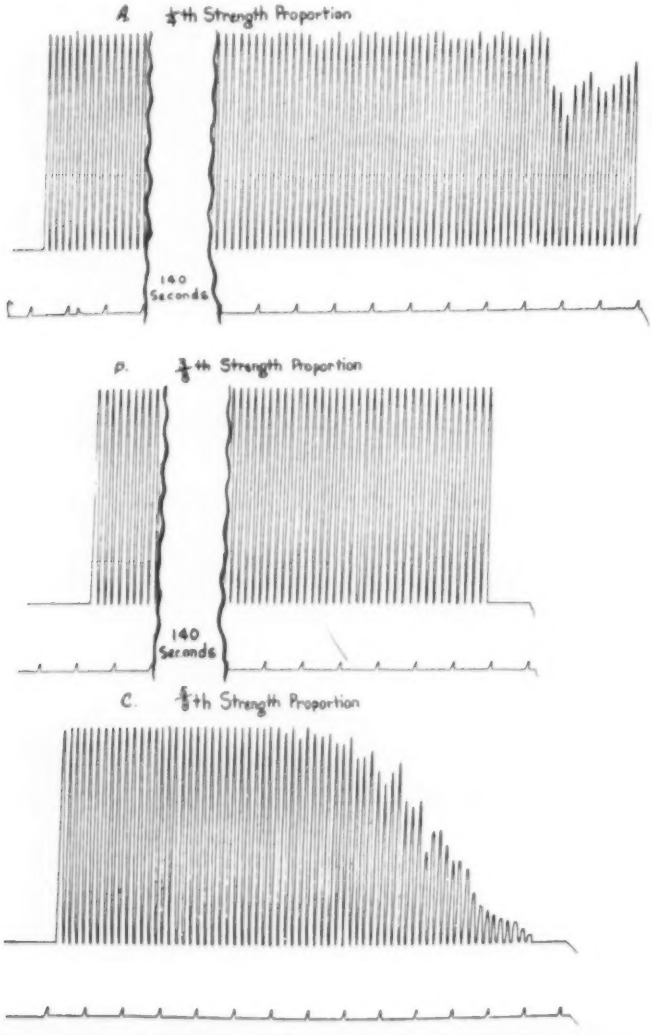
ELBOW FLEXION KYMOGRAPH TRACINGS - Unlimited Time Bouts

FIGURE 3

ion movement was selected, as in this movement greatest strength is achieved at 180 degrees, with arm parallel to the side of the body.

Two-Minute Test Bouts: In determining the precision of shoulder flexion ergography, the procedures found essential in the elbow flexion process were followed. During the first week of the study, the testers were instructed in testing techniques and participated in a number of practice sessions. For the second week, thirty-two subjects were given two tests of two minutes each, with ten minutes rest between bouts and with one-eighth proportion of shoulder flexion strength on the ergograph carriage. The correlation between the tests was 0.98, nearly all the subjects exactly repeating their performance each time. Thus, it was demonstrated that single-bout shoulder flexion ergography can be performed with a high degree of precision.

Next, shoulder flexion ergograph tests



SHOULDER FLEXION KYMOGRAPH TRACINGS - UNLIMITED TIME BOUTS

FIGURE 4

were conducted utilizing one-fourth proportion and, as before, with a time limit of two minutes. High consistency was again achieved for two tests: twenty-three subjects had duplicate results, while discrepancies were found in nine. A similar result was obtained during the fourth week when three-eighth proportion was used and the rest period was thirty minutes. For the most part, the kymograph tracings were true rectangles, indicating that the fatigue effect of this amount of exercise was not usually sufficient to decrease the distance the load could be lifted.

Unlimited Time Bouts: The question of the amount of ergograph load for shoulder flexion testing was becoming a paramount issue. As demonstrated above, a three-eighths proportion was sufficient to exhaust elbow flexion muscles in approximately two minutes. With shoulder flexion, many subjects maintained full movements for this length of time.

During the first week of unlimited time testing, one-fourth proportion of each subject's shoulder flexion strength was placed on the ergograph carriage. The subjects exercised for long periods of time, in some instances for a half hour and over. The kymograph tracing in figure 4 illustrates this situation. The subject was stopped at the end of 280 seconds; fatigue was noticeable at the end of this time; but the performance was erratic. Similar results were obtained when the weight was increased to a three-eighths proportion (fig. 4B). Ergographic precision under these conditions was not possible.

Finally, the ergograph loads were increased to five-eighths proportion. This amount proved sufficient to induce exhaustion in a reasonable length of time. The kymograph tracing (fig. 4C) shows a rectangle for the first minute, followed by a consistent decline to exhaustion in the next 70 seconds. The correlation between repeated test bouts with this strength proportion given on separate days was 0.85. Thus, precise results were achieved with single-bout shoulder flexion ergography.

Summary

In this research, procedures necessary to achieve precision in single-bout elbow flexion and shoulder flexion ergography under conditions of exhaustion testing were investigated. Objectivity coefficients between 0.75 and 0.85 were obtained for these tests. Inasmuch as the muscle-conditioning effect of repeated exhaustion bouts was found to be pronounced and was not compensated for in the study, these results were considered satisfactory.

The essential feature in achieving precision in single-bout ergography was in determining the proper load to place on the ergograph carriage. These loads may be determined objectively for each individual as a proportion of the strength of the muscles directly involved in the movement. For the subjects utilized in this research and with an eight-inch ergograph lever arm, the proportions were: three-eighths of elbow flexion strength for elbow flexion ergography; and five-eighths of shoulder flexion strength for shoulder flexion ergography. The greater proportion required for the shoulder flexion movement is attributed to the fact that the muscles are able to exert their greatest strength when the shoulder is fully extended; for elbow flexion, this position is between 100 and 140 degrees, with a 28 per cent decrease in strength at the extended position.

Acknowledgement is made to Donald K. Mathews, research laboratory supervisor, and the following graduate students at Springfield College, who assisted in the collection of test data and statistical computations: Edwin W. Allen, Theodore Dreisbach, Richard L. Geser, Dean W. Houghton, Avery S. Liscomb, Roper McNair, Edward L. Mitchell, and Jack O. Proud. Appreciation is also expressed to Dr. F. A. Hellebrandt, Department of Physical Medicine and Rehabilitation, University of Illinois Research and Educational Hospitals, for advice and instruction in the use of the ergograph.

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At the foot of Lake Michigan, in the heart of the richest valley on the globe, towers Chicago, greatest metropolis of the Middle West. A mere hundred years ago it stood an obscure Indian outpost on a more or less uncertain frontier. Chicago's recorded history really begins with the first exploration by Louis Joliet in 1673. It is situated in the richest section of the Mississippi Valley and within a few hundred miles of both the nation's center of population as well as its geographical center, Chicago occupies a strategic location unparalleled anywhere. Other thriving focal cities on other sectors of the earth may claim to be the spots around which all else revolves, like Paris with its radii reaching out to all parts of Europe, Shanghai or Singapore with their important positions in the Asiatic network, or Cairo with its influence on Northern Africa, but Chicago overshadows them all. At the very heart of the richest, most progressive and fastest production nation of all time, it has no peers.

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Chicago is sometimes naive, often surprising and always colossal. It grew from a hamlet to the country's second largest city in a sensational sixty years. It has the world's largest hotel, as much railroad track as all of New York State, and it produces nearly half the nation's candy and radar equipment. Its principal amusement park is bigger than Coney Island.

Typically, Chicagoans don't know where their name came from. Early maps spell it Chikago, Chicagou, Chekago, Checagou and Chicago. Unaware that they were making history, the settlers didn't bother with etymology. By the time their curiosity was aroused the source of the word was lost. Of the versions which persist, the Association of Commerce naturally favors the story that Chicago was an Indian word meaning strong. The romanticists say it came from the name of an Indian chief, Chikagou, who lived nearby. Francophiles say it's from the French. Realists — by far the majority among Chicagoans — say it means wild onions.

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The famous Buckingham Fountain in Grant Park.

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TEAM TRAINING FOR UPPER-EXTREMITY PROSTHETIC SERVICE

Since World War II there have been many advances in the design of upper extremity prostheses. Engineering research and development has been supported by the Government under the supervision of the National Research Council, and has been a joint project of the Army, Air Force, Navy, and Veterans Administration. The basic biomechanical research has been accomplished at the College of Engineering of the University of California at Los Angeles in cooperation with Northrop Aircraft, Incorporated and the A. J. Hosmer Corporation. Their work has been outstanding in designing more efficient functional equipment for the upper extremity amputee who traditionally in the past, except for the bilateral cases, have failed to wear prostheses in a large percentage of instances.

These projects to begin with were primarily in the field of engineering. As might be expected, knowing the impressive strides made in the past in overcoming problems of design and manufacture in so many fields of engineering endeavors, progress was soon apparent in the design of artificial limbs. Success, however, in this project is entirely dependent on the actual use of the new devices by the patient. This phase of development goes far beyond the concept of engineering and involves the skill, experience and art of a variety of specialists concerned with the broad field of Physical Medicine and Rehabilitation. In this instance those concerned include the surgeon, physiatrist, physical therapist, occupational therapist, vocational counsellor, social service worker, often a psychiatrist and last, but of course of utmost importance, the prosthetists or limb manufacturer. This group of specialists in effect composes a team, each member of which contributes his own particular skill and knowledge in order to successfully rehabilitate the amputee.

The types of new prosthetic devices which have been developed for upper extremities have been recently described by Thorndike.[1] In brief these research projects have achieved methods of producing plastic laminate sockets which are well fitted through the use of wax trial sockets, are durable, light and easily cleaned. New materials are also used for the harness (vinyon plastic webbing) and stainless steel Bowden cable with housing for transmission of power to the terminal devices. New types of elbow hinges for the above elbow amputee are

available to allow locking in 11 different angles without manual control, also polycentric hinges to increase range of motion and soft leather hinges to permit supination and pronation for below elbow amputees. Special units may increase rotation without manual control and permit wrist flexion which are so important in bilateral amputees. The terminal devices now make controlled closing rather than opening available, also 2 load closing and functional prehension in a semicosmetic hand. The hooks are available in varying sizes, shapes and weights depending on the needs of the patient. Suspension and harnessing have been simplified and improve the efficiency of operation. There is still no mechanical substitute for sensation and the electrically powered arm turned out to be a failure. Other details of fabrication and fitting which are so important, still to a large extent remain in the province of skillful craftmanship by the prosthetists applied to the patient's individual needs.

The practical use of these prostheses was given a clinical trial by a group from Chicago approximately a year ago. Sufficient success was noted to make it apparent that this new knowledge and skill be dispersed as rapidly as possible to those caring for amputees, both for the veteran and civilian groups of patients. It was also apparent that success was dependent on the team approach. As a consequence of this experience a series of upper extremity prosthetic training courses for the treatment team have been organized at the school of Engineering at the University of California at Los Angeles, the first course having just been completed by teams from the New York City and Boston areas.

The prosthetists had six weeks to learn the art of accurately fabricating and fitting, light and strong, easily washable laminated plastic sockets, incorporating the new types of elbow hinges, locks, and terminal devices together with efficient methods of harnessing for securing the equipment and operating the terminal devices. The physical and occupational therapists had three weeks to learn how to teach patients to operate the different types of prostheses and the principles of training to develop functional skill. The surgeons, and physiatrists, course was for one week, the last two days consisting of actual clinical training for the individual teams from different centers working together in prescribing prostheses for new patients. The prescriptions decided on with the help of the instructors at the University of California are then put into use by the following class of student prosthetists. Plans have also been set up to make it possible to do a followup research study on the practical application of this type of prosthetic service with each of the participating teams.

All those attending this recent course, including the author, were impressed by the engineering achievements which have been made. It was also most evident that the team approach is essential for success. First of all the surgeon must know more about prosthetic devices in planning surgery and in directing the patient so that a proper prescription for the prosthesis is written. This latter action involved team activity so that proper attention is given to psychological, social, and vocational factors, and skeletal muscular deficiencies requiring preprosthetic training as well as details of apparatus prescription. At the same time arrangements must also be outlined for prosthetic training and the probable rehabilitation goals determined. It is recommended that as many rehabilitation facilities as possible avail themselves of this opportunity to train a team to treat more successfully the patient with upper extremity prostheses.

Reference

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MEDICAL NEWS

Members are invited to send to this office items of news of general interest, for example, those relating to society activities, new hospitals, education, etc. Programs should be received at least six weeks before the date of meeting.

PERSONALS

Donald A. Covalt, M.D., New York City, presented papers on "Rehabilitation of the Hemiplegia Patient" and "Early Management of Patients with Spinal Cord Injury" at the Atlanta, Georgia Graduate Medical Assembly on February 23, 1953. — **Michael Dacso**, M.D., New York City, was a guest lecturer at a special seminar on gerontology held at the University of Kansas Medical Center in Kansas City on March 25, 1953. — Doctors **George G. Deaver, Edward Lowman** and **Joseph Benton** of New York City, participated in a panel on "Rehabilitation" at the annual meeting of the American College of Physicians in Atlantic City, April 15, 1953. — **Harriet E. Gillette**, M.D., Atlanta, Ga., is serving on the Committee on Problems in Chronic Illness of the Fulton County Medical Society. — **Frances A. Hellebrandt**, M.D., Chicago, directed a demonstration "Rehabilitation Clinic" at the ninth clinical conference of the Chicago Medical Society. — **Gerald Hirschberg**, M.D., Oakland, Calif., participated in a symposium of upper extremity disabilities at a recent meeting of the California Chapter of the American Physical Therapy Association.

Herbert Kent, M.D., Indianapolis, discussed the "Concepts of Physical Medicine and Rehabilitation" at a meeting of the Indiana Health Council on March 16, 1953. Doctor Kent is now on active duty with the United States Air Force. — **Frederic J. Kottke**, M.D., head of the department of physical medicine at the University of Minnesota has received a grant of $18,078 from the United States Public Health Service. — **Miland E. Knapp**, M.D., Minneapolis, spoke on "Rehabilitation" at the Annual Postgrad Convention of the School of Medicine of the College of Medical Evangelists at Los Angeles; Doctor Knapp also spoke on "Rehabilitation of Severe Poliomyelitis Paralytics" at the annual meeting of the Iowa State Medical Society and was a guest speaker at a March of Dimes benefit supper given by the Kandiyohi County March of Dimes Chapter on January 5, 1953 at Willmar, Minnesota. — **Frank H. Krusen**, M.D., Rochester, Minn., participated in a conference of "Rehabilitation" at the VA Hospital, Milwaukee, Wis. — **Christopher J. McLoughlin**, M.D., Atlanta, Ga., is serving as Chairman of the Committee on Radio and Public Relations of the Fulton County Medical Society.

Louis B. Newman, M.D., Hines, Ill., gave an illustrated lecture on "Total Rehabilitation in Neurological Disabilities" on March 3, 1953. Doctor Newman addressed the Chicago Board of Education personnel associated with the Schools for the Physically Handicapped Children; Doctor Newman also participated in a seminar on Rheumatoid Arthritis sponsored jointly by the Chicago Rheumatism Society and the Chicago Medical Society on February 19, 1953. — **Constantine G. Psaki**, M.D., Philadelphia, has organized and developed a Physical Medicine Rehabilitation Department at the Sidney Hillman Medical Center of Philadelphia. — **David Rubin**, M.D., formerly of the Kabat-Kaiser Institute at Santa Monica, California is now on active duty with the U. S. Army—**Howard A. Rusk**, M.D., New York City, will head a rehabilitation mission to Korea. This is one of the first major activities of the American-Korean Foundation. — **William J. Shriber**, M.D., Boston, is Secretary of the section on Physical Medicine of the Massachusetts Medical Society.—**Samuel Sverdlik**, M.D., New York City, participated in an assembly on prosthetic and orthopedic devices held at St. Vincents Hospital School of Nursing, New York, April 16, 1953. — **Jean J. Vivino**, M.D., and **Darell C. Crain**, M.D., Washington, D. C., participated in the Third National Conference on Placement of Severely Handicapped, March 23, 1953. — **Eugene Weissenberg**, M.D., formerly of St. Louis, Mo., is now at the Veterans Administration Hospital, Hines, Illinois. — **Bert C. Wiley**, M.D., is now Director of Physical Medicine at the Conemaugh Valley Memorial Hospital, Johnstown, Pennsylvania. — **Ralph E. Worden**, M.D., Columbus, Ohio was recently appointed director of a new rehabilitation center at Ohio State University.

Federal Communications Commission

Commission Expects Medical Diathermy Users to Comply with Rules Part 18 By June 30, 1953

The Commission on June 25, 1952 adopted a Report and Order amending Section 18.51 of the Rules and Regulations Relating to Industrial, Scientific, and Medical Service to extend until June 30, 1953 the applicable date of Part 18 to medical diathermy equipment manufactured prior to July 1, 1947.

This extension appeared necessary because of the unavailability of conforming equipment to replace those machines manufactured prior to July 1, 1947, which could not be operated in accordance with the requirements of the rules.

In that Report and Order the Commission advised all interested parties that if further requests for extension of the applicability date were sought, such requests would be considered on an individual basis, taking into consideration the efforts made by the users of non-conforming equipment to replace it during the period for which the extension was granted.

The Commission continues to receive reports of interference caused by the operation of medical diathermy equipment. With few exceptions, the equipment responsible for the interference is equipment which was manufactured prior to July 1, 1947, and which does not comply with the requirements of Part 18, particularly with respect to the suppression of emissions outside the frequency bands allocated for medical diathermy equipment.

Information available to the Commission indicates that type approved diathermy equipment is now available for early delivery. Accordingly, all interested persons are advised that the Commission has no present intention of adopting any further general extension of the time for compliance with the applicable portions of Part 18 of the rules beyond June 30, 1953.

NEW PUBLICATION

A new 44-page monograph entitled "Manual of Procedures in The Children's Division, including Objectives, Philosophy, Policies and Staff Functions of the Children's Division" was written by George D. Deaver, M. D., and the staff of the Children's Division in collaboration with the Association for the Aid of Crippled Children, New York City. Copies of the monograph are available at $1.00 each from the Institute of Physical Medicine and Rehabilitation, 400 E. 34th Street, New York 16, N. Y.

AMERICAN COLLEGE OF ALLERGISTS

The annual conclave of The American College of Allergists will be held this year at the Conrad Hilton Hotel in Chicago, April 24 to 29, 1953. The first four days will be devoted to instruction under the tutelage of recognized authorities and the last three to a discussion and reporting of recent advances in the field of allergy by the investigators themselves.

AMAzing Story

"The AMAzing Story" is the title of a new booklet designed to acquaint lay people with the services rendered the general public by the AMA. The whole is presented in eight pages with a minimum of reading matter and a maximum of illustration. The booklet may be obtained, free of charge, from the American Medical Association, 535 N. Dearborn St., Chicago 10, Ill.

CONGRESS MEMBERS PARTICIPATE IN MEETING OF FLORIDA MEDICAL ASSOCIATION

At the seventy-ninth annual meeting of the Florida Medical Association, Kenneth Phillips, M.D., of Miami presented a paper "Ultrasonic Therapy: A Review of Its Present Status and Future Possibilities." This paper was discussed by Edward F. Carter, M.D., of Tampa and Samuel B. Kleinman, M.D., of Miami Beach. Abraham R. Hollender, M.D., of Miami Beach presented a paper "Sore Tongue: Etiologic and Therapeutic Aspects."

CONFERENCE OF CHILD RESEARCH CLINIC TO BE HELD

The annual spring conference of the Child Research Clinic of The Woods Schools of Langhorne, Pa., will be held Saturday, May 23 at the Bellevue-Stratford Hotel in Philadelphia. Topics to be discussed will include diagnosis and treatment of the exceptional child in the six to twelve age group who is mentally or physically retarded.

FIRST REPORT RELEASED

The first report of the Joint Expert Committee on the Physically Handicapped Child published by the World Health Organization has been released. The report contains the collective views of an international group of experts.

BAY STATE SOCIETY

The Bay State Society for the Crippled and Handicapped, Inc., held open house in March at the rehabilitation centers in Boston, Worcester and Springfield.

NEW DIET MANUAL

The American Heart Association and its affiliates have issued a new, comprehensive diet handbook, Food for Your Heart, for use by physicians in the dietary management of heart patients. The manual incorporates nine diets, sample menus, and the latest information on nutrition and heart disease. The booklet may be obtained from affiliated Heart Associations or from the American Heart Association.

FELLOWSHIPS AVAILABLE

A limited number of fellowships are available to prepare properly qualified candidates as instructors and administrators in physical therapy schools. Application may be made to the National Foundation at any time during the year. Selection of candidates will be on a competitive basis by the Fellowship Committee. All Committee decisions are accepted as final by the National Foundation.

Each recipient must affirm his intention that, immediately upon completion of his fellowship, he will accept employment in the United States or its territories on the staff of a school of physical therapy approved by the Council on Medical Education and Hospitals of the American Medical Association and will continue in such a position for at least two years.

Detailed information and application blanks may be obtained from: Division of Professional Education, The National Foundation for Infantile Paralysis, 120 Broadway, New York 5, New York.

MULTIPLE SCLEROSIS DRIVE

The National Multiple Sclerosis Society launched its annual fund raising drive on March 2 with a goal of $1,200,000. The society desires to expand its program of research, clinics, rehabilitation, and service throughout the nation.

MANUAL FOR ARTHRITIS CLINICS

A Manual for Arthritis Clinics has just been released for distribution by the Arthritis and Rheumatism Foundation. The manual was published jointly with the National Institute of Arthritis and Metabolic Diseases. The material is considered definitive as it was prepared by a special committee of the New York Rheumatism Association in cooperation with the New York Chapter of the Foundation. The book is aimed to supply needed information on setting up an efficient clinic.

Priced at 50 cents, copies may be obtained by writing to any of the 32 Chapters of the Foundation or to national headquarters, 23 W. 45th St., New York 36, N. Y.

NEW FILM SHOWS HOW ANTIBIOTICS ARE MADE

The amazingly complex process of manufacturing the so-called wonder drugs, such as penicillin, is simply and dramatically set forth in a new 25 minute sound film entitled ". . . And the Earth Shall Give Back Life."

Filmed against a background of the actual production of penicillin in a manufacturing laboratory, the film explains just what the wonder drugs are, what they do and how and when they are used.

This motion picture is available for all types of group showings. For information write: Motion Picture Department, E. R. Squibb & Sons, 745 Fifth Ave., New York, N. Y.

FIVE YEAR SPASTIC RESEARCH FINANCED

Basic problems of the deeper brain areas in cerebral palsy will be studied during the next five years at Children's Memorial Hospital in a project financed by the Illinois-Eastern Iowa District of Kiwanis International.

The Kiwanis leaders and hospital and medical representatives dedicated a bronze plaque at Children's Hospital to mark the inception of this research project.

OBSOLETE DIATHERMY APPARATUS

After June 30, 1953, all outmoded diathermy equipment used for therapeutic purposes must meet the requirements of the Federal Communications Commission. Surgical diathermy apparatus is exempt. A list of accepted diathermy apparatus may be obtained by writing to the Council on Physical Medicine and Rehabilitation, American Medical Association, 535 N. Dearborn Street, Chicago 10, Illinois.

BOOK REVIEWS

The reviews here published have been prepared by competent authorities and do not necessarily represent the opinions of the American Congress of Physical Medicine and Rehabilitation and/or the American Society of Physical Medicine and Rehabilitation.

DISEASES OF THE NERVOUS SYSTEM. Described for Practitioners and Students. By *F. M. R. Walshe,* M.D., D.Sc., F.R.S., Fellow of the Royal College of Physicians of London; Fellow of University College, London; Consulting Physician to University College Hospital, and to the National Hospital for Nervous Diseases, Queen Square. Seventh edition. Cloth. Price, $5.50. Pp. 365, with illustrations. The Williams & Wilkins Company, Mt. Royal and Guilford Aves., Baltimore 2, 1951.

This is a beautifully written textbook, which reads more like the manuscript of a polished lecture than the compilation of anatomic and pathologic data so common in most American neurology texts. The essentials of neurology as required by the general practitioner and student are well set forth without unnecessary detail and this should be for them a valuable study guide. It is not detailed and complete enough for the neurologist to use as a reference and contains no bibliography.

THE TREATMENT OF INJURIES TO THE NERVOUS SYSTEM. By *Donald Munro,* M.D., F.A.C.S., Surgeon-in-chief, Department of Neurosurgery, The Boston City Hospital; Associate Professor of Neurosurgery, Boston University School of Medicine. Cloth. Price, $7.50. Pp. 284, with illustrations. W. B. Saunders Company, West Washington Square, Philadelphia 5, 1952.

The author states that this book is written for the general practitioner and general surgeon, but certainly specialists in neurology, neurosurgery, physical medicine and rehabilitation and all those concerned with the care of paraplegics will want this text readily available in their libraries. The text is practical, presenting details of medical, surgical, and nursing care. Also full consideration is given to more special procedures of value in relation to respiratory and urinary function, particularly the latter for which the author is widely known by his previous publications. Consideration is given to bracing and gait training for paraplegics, although not in enough detail to satisfy the physiatrist. The section on peripheral nerve injuries would be improved by more detailed discussions of electrodiagnostic methods, splinting and the use of procedures in physical medicine including occupational therapy. As far as Neurosurgery is concerned this is an authoritative text, based on a wealth of experience unusual in most civilian practices. It is well written and attractively published. The illustrations are good, but an increase in their number would be valuable.

THE SCIENCE OF BIOLOGY. By *William C. Beaver,* Ph.D., Head of the Department of Biology, Wittenberg College, Springfield, Ohio. Fourth edition. Cloth. Price, $5.85. Pp. 895, with 375 illustrations. The C. V. Mosby Company, 3207 Washington Blvd.; St. Louis, 1952.

A prodigious amount of biological information is packed into this book. An introductory section takes up some general considerations including cytology, with an interesting chapter on microscopes. The second chapter is devoted to plant biology, the third to animal biology, and the fourth to numerous applications such as ecology, genetics, agriculture, sanitation, and conservation. The author's unaffected style and the wealth of illustrations make every page interesting and profitable. The glossary is better than most, except for the ambiguous method used to indicate pronunciations. There is a good index. The book is highly recommended to any physician who wishes to have a good reference book on biology for his library.

LIVING WITH DIABETES. By *Edward Tolstoi,* M.D. Cloth. Price, $2.00. Pp. 90. Crown Publishers, Inc., 419 Fourth Ave., New York 16, 1952.

This 90 page text is intended for use by both physician and patient. It is of particular interest to the patient in that it covers briefly but adequately and in an easily understandable style the diagnosis, treatment methods and complications of diabetes mellitus. The use of insulin rather than a rigidly controlled and weighed diet is set forth in some detail. In addition there are sections

concerning pregnancy with diabetes and also the natural history of the disease as it is found in both the young and elderly patient. The book is recommended as interesting and worthwhile reading for both physician and patient.

AUDITORY TRAINING FOR THE DEAF. By *Mary Wood Whitehurst* and *Edna K. Monsees*. Paper. Price, $3.12 postpaid. Pp. 99. The Volta Bureau, 1537 35th St. N.W., Washington 7, D.C., 1952.

This book offers materials for the use of people engaged in efforts to help others with impaired hearing. The aim is to increase, by systematic work, the ability of the deafened person to interpret those sounds which he still is able to hear. The thirty-eight lessons in this book proceed from the easier vowel sounds to the more difficult, and the lessons on consonants bring out the contrast between the voiced and unvoiced sounds. Much of the material can also be used in lessons on speechreading (lipreading). It is neatly printed and can be highly recommended.

MICROBIOLOGY AND PATHOLOGY FOR NURSES. By *Mary Elizabeth Morse*, M.D., *Martin Frobisher*, Jr., Sc.D., Chief, Bacteriology Section, United States Public Health Service, Communicable Disease Center, Atlanta, Ga., *Lucille Sommermeyer*, R.N., B.S., M.Ed., Nurse in Charge, Nursing Research Laboratory, United States Public Health Service, Communicable Disease Center, Atlanta, and *Raymond H. Goodale*. Third edition. Cloth. Price, $4.75. Pp. 815, with 271 illustrations. W. B. Saunders Company, 218 W. Washington Sq., Philadelphia 5; 7 Grape St., Shaftesbury Ave., London, W.C.2, 1951.

The purpose of the volume, to quote the preface, is to "meet the needs of schools of nursing" and, in general, it fulfills this purpose. The portion devoted to Microbiology is divided into four units: General Principles; Inhibition, Destruction and Removal of Microorganisms; Infection, Immunity and Allergy; and Special Microbiology. The units are well illustrated and are oriented practically toward hospital problems. Illustrations are numerous and excellent. The text is clear and complete for the purposes of the volume. The subject of tissue Pathology is presented in two units: General Pathology; Applied Pathology. The range of topics is complete, and the text accurate to the point of minor differences of opinion among pathologists; but the presentations are necessarily brief. It will be necessary for the instructor to elaborate some of the most briefly discussed subjects. The illustrations of gross specimens are fair; those of the histologic preparations are poor. A unit is given to Clinical Pathology; it describes the specimens commonly examined, gives the normal values, briefly presents some techniques and offers correlations of clinical pathologic findings with some of the important diseases. The volume is an adequate basic text in Microbiology and may serve well as a guide for instruction in Pathology for nurses and also as general instruction for physiotherapy students.

PSYCHOLOGY IN THE SERVICE OF THE SCHOOL. By *M. F. Cleugh*. Cloth. Price, $3.75. Pp. 183. Philosophical Library, Inc., 15 E. 40th St., New York 16, 1951.

This book is intended to be of practical help to teachers, parents, and welfare workers in dealing with minor and major forms of deviant behavior in children. Its unaffected style and rich illustrative material make it readable. The nature of the contents is well indicated by the chapter headings: Judgments and Misjudgments (as to the significance of puzzling behavior), The Meaning of Maladjustment, Fight and Flight, The Handling of Aggressive Reactions, The Handling of Regressive Reactions, A Mixed Bag of Examples, A Practical Guide to Action, and Child Guidance.

The energy and inventiveness of children seems inexhaustible, and the difficulty experienced at times by even the most mature and well-trained people, whether parents or teachers, in keeping from getting emotionally involved is well-known. When the temptation to "blow one's top" becomes nearly irresistible, this book will help an embattled adult to keep his grip on things. It is well provided with bibliography and indexes and is to be recommended alike to lay and professional readers.

BIOCHEMICAL PREPARATIONS. Volume II. *Eric G. Ball*, Editor-in-Chief. Cloth. Price, $3.00. Pp. 109. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1952.

This is the second volume of a series of books which give especially authoritative directions for the preparation of substances used in biochemical research, supplementing a similar, larger series of volumes on the synthesis of especially important organic compounds. Among the most interesting of the 23 substances considered in this volume are cytochrome C, oxycasein, sodium pyruvate, glutathione, and a variety of sucrose uniformly labelled with radioactive carbon 14. The list also includes some organic phosphates, protein derivatives, esters, and enzymes. Edited and printed with extraordinary attention to detail, the volume can be recommended to anyone undertaking investigations in which it may be essential to start with organic substances of indubitable purity.

THE MANAGEMENT OF THE "HOPELESS" CASE. By *C. J. Gavey*, M.D., F.R.C.P., Physician, Westminster Hospital, London. Buckston Browne Prize Essay, Harveian Society of London, 1950. Cloth. Price, 9s. Pp. 45. H. K. Lewis & Co., Ltd., 136 Gower St., London, W.C.1, 1952.

It is fortunate that the British sponsor prize essays and theses. This short essay won the Buckston Browne Prize in 1950. The quality of this work certainly justifies its publication. The material presented is concerned with the "philosophical aspects of medicine" rather than "precise scientific truths." Well chosen quotations are used throughout the book, and the acts of several great physicians in their care of the dying patients are given. Osler's masterly management of Mary Macdougall, the daughter of Doctor Macdougall, and of little Janet whom he visited twice a day for a month and to whom just before she died he brought a red rose as a symbol to comfort her and the family, is truly touching and illustrative of what a really great physician can do. The two final pages on euthanasia are summed up on this quotation — "The world is not ready for the established practice of euthanasia, and the decision as to when, if ever, a patient should be helped over the border, rests on a higher plane of judgement than can be laid down in rules or law."

LIVING AGENTS OF DISEASE. By *James T. Culbertson*, Executive Secretary, Microbiology and Immunology Study Section, National Institutes of Health, United States Public Health Service, Bethesda, Md., and *M. Cordelia Cowan*, Educational Director of Postgraduate School, Woman's Hospital, New York. Cloth. Price, $5.50. Pp. 624, with 71 illustrations. G. P. Putnam's Sons, 210 Madison Ave., New York 16, 1952.

This is a text book of microbiology for physical therapists, nurses and other personnel in the medical fields. In addition to the factual information that is usually given in a text book covering this subject, the authors include discussion on how these various organisms have influenced mankind, and what efforts are being made to control them. The work of the United States Public Health Service is stressed. This method of presentation makes the subject more interesting.

APPLIED PHYSIOLOGY. By *Samson Wright*, M.D., F.R.C.P., John Astor Professor of Physiology, University of London Middlesex Hospital Medical School; Examiner in Physiology to the Royal College of Surgeons of England and the Conjoint Board; Formerly Examiner in Physiology to the Universities of Oxford, London and Leeds. Ninth edition. Cloth. Price, $9.50. Pp. 1206, with illustrations. Oxford University Press, 114 Fifth Avenue, New York 11, 1952.

The ninth edition of this book, like the first, is unique in physiological literature as a compendium of information, for advanced students, on the effects of stress and disease upon the activities of the body. The aim is not to explain phenomena in terms of theories but to assemble relevant facts, and the book's value lies largely in a wealth of quantitative information, which is clearly set forth. Every aspect of physiology, including reproduction, is well covered, although the discussions of vision and hearing might be criticized as brief. Much important new material has been added, particularly in the fields of endocrinology and respiration. The additions include about 200 illustrations. The book can be recommended not only to medical students as being of fundamental importance, but also to medical readers in general as one important means of keeping up with developments in the basic sciences.

PERSONAL AND COMMUNITY HEALTH. By *C. E. Turner*, A.M., Ed.M., S.Sc., Dr.P.H., Professor of Public Health Emeritus, Massachusetts Institute of Technology; Formerly Associate Professor of Hygiene in the Tufts College Medical and Dental Schools; Sometime Member of the Administrative Board in the School of Public Health of Harvard University and the Massachusetts Institute of Technology; Formerly Visiting Professor of Health Education, School of Public Health, University of California. Ninth edition. Fabrikoid. Price, $4.25. Pp. 659, with illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1952.

Few subjects are more difficult to teach than hygiene, a subject in which answers must often be given to questions when the factual basis that ought to be supplied by physiology is lacking. Because of the difficulty of defining and discovering what is normal, innumerable crackpot ideas have at one time or another associated themselves with what ought to be a science. One must therefore respect a book which represents years of painstaking elimination of the misleading and the unfounded, with gradual incorporation of the reliable and the accurate.

The text of the present edition exhibits very few faults. It errs, if at all, on the side of the conventional and the conservative, as in the discussions of autoerotic activity on pp. 316 and 317, and in the retention of the old name for uterine tubes on p. 310. It seems imbued with the notion, inculcated by modern advertising, that the sebaceous secretions are good for nothing and that all

body odors are unpleasant. It is misleading in the allusion, on p. 292, to the shortcomings of leather footwear (which is intrinsically far less harmful than rubber) and not up to date in the statements as to the cause and treatment of athlete's foot. The paragraph on dreams is too brief to answer a question most likely to be asked by adolescent boys or to hint what the author's ideas might be on the interpretation of dreams, whether psychoanalytic or otherwise. Considering that quack psychologists exist and that an unauthentic or dilettante variant of psychoanalysis recently achieved wide popularity, some words on this subject would be timely. The glossary abounds in small inaccuracies, and is about average in this respect.

On the whole, however, the book must be commended for the great wealth of positive information it contains, for attractive illustrations, and for a good index.

RARE MANIFESTATIONS OF METABOLIC BONE DISEASE. Their Practical Importance. By *I. Snapper*, M.D., Ph.D., Physician and Director of Medical Education, Mt. Sinai Hospital, Clinical Professor of Medicine, Columbia University College of Physicians and Surgeons, New York City. Leatherette. Price, $3.00. Pp. 96, with illustrations. Charles C Thomas, Publisher, 301-327 East Lawrence Ave., Springfield, Ill., 1952.

It has long been appreciated that the internal milieu of living material plays an important biologic role, and that the study of its metabolic activity conveys invaluable information toward clinical progress and establishment of diagnostic criteria. Today modern medicine in general suffers from an embarrassment of riches pertaining to the vast and distinguished contributions on this topic, so that its trees are indistinguishable at times from the forest. Thus it is a timely tribute to the acuity of the publishers of the "American Lecture Series" to have included in its program a concise exposition by a foremost authority concerning the "Rare Manifestations of Metabolic Bone Disease." On this subject few can speak with greater authority than Snapper, who has presented within the frame of 96 pages a highly creditable discussion of the essential data influencing osteogenesis, calcium and phosphate metabolism in diseased states of the skeletal system. Within the space of five chapters, including a substantial bibliography, the author reviews the abnormal metabolism in hyperparathyroidism with limited and unlimited skeletal involvement; multiple myelomas with limited or without skeletal complications. A special chapter is devoted to the biochemical syndrome found in certain disease with rapid demineralization other than hyperparathyroidism, in which significant signs of hypercalcemia, hypophosphatemia and hypercalcuria may be present. Thus the salt content varies, making this very difference a diagnostic criterion in differentiating the various diseases within this category. Eleven tables, 18 illustrations and pertinent case histories are of material aid in clarifying the contents of this valuable monograph, adding to the distinction of the already distinguished "American Lecture Series."

DEUTSCH-ENGLISCHES, ENGLISH-DEUTSCHES WORTERBUCH FUR ARZTE. By Prof. med., Dr. phil, Dr. med. dent. *Fritz Lejeune*. Vol. 1, German-English. Cloth. Price, $6.00. Pp. 1349. Georg Thieme, Diemershaldenstrasse 17, (14a) Stuttgart-O, 1951.

Announcement of the publication of the first of two volumes of a new German-English Dictionary is welcome news in our bilingual cultural world. While it has long been accepted that science does not recognize the restriction of national boundaries, it is regrettably true that difference in language often plays a deterrent role in dissemination of knowledge. In the past Latin served as the common denominator for science and philosophy. Today this common maternal bond has been weakened by a competitive national chauvinism which virtually has destroyed international concord and has restricted understanding of thought and progress generated outside of limited national borders. The need therefore for a "Worterbuch" or dictionary to increase the mutual understanding in current knowledge between such dynamic languages as English and German is obvious. This volume is a splendid commentary on how informative 43,000 key words can become for physicians who wish to find in translation the concise nuance or synonym. The words are German, clearly translated into English of current or even slang usage. This work has all the indices of superior quality and labor and will rank as a "must" with those who are in constant touch with the scientific progress of the German speaking world. The author has earned the deep respect of an appreciative medical profession.

WHEN DOCTORS ARE PATIENTS. Edited by *Max Pinner*, M.D., and *Benjamin F. Miller*, M.D. Cloth. Price, $3.95. Pp. 364. W. W. Norton & Company, Inc., 101 Fifth Ave., New York 3, 1952.

This is a revealing and highly instructive book, in which thirty-three physicians describe their own personal reactions to serious illnesses from which they themselves have suffered. The range of medical problems discussed includes heart disease, cancer, polio-

myelitis, tuberculosis, epilepsy, drug addiction, alcoholism, neurosis, deafness, blindness, arthritis and certain rare diseases which are of unusual interest.

One of the striking facts concerning this unusual book is that practically every physician whose writings are included, when he discusses his own serious illness, stresses the psychologic and social rather than the physical aspects of his disease. This led the late Dr. Max Pinner, one of the editors of the volume, to comment in the preface, "This collection of case reports can only emphasize again, and, I believe, in a peculiarly urgent and moving way, how essential it is to treat the whole patient, unless we as physicians want our patients to seek relief in pseudoreligious or fraudulent medicine."

There is much in this book of interest to the physiatrist. For example, M. C. Winternitz in discussing an attack of coronary artery disease concluded that "Some kind of physiotherapy might have been not only permissable but also desirable to avoid the complete skeletal debilitation that followed a protracted inactivity." John Crawford in discussing living without a balancing mechanism mentioned, "Ten days of physiotherapy restored the strength in the limb so that it no longer collapsed under me when I put my weight on it." Max Samter in discussing deafness mentioned the importance of supplementing the service in otolaryngology with "sections of speech and hearing rehabilitation." And he noted, as so many other physicians observed, "A deep appreciation for honesty tempered with the willingness 'to do something.'" He loathed simple reassurance.

Merritt Low gave many interesting observations concerning the physical treatment of poliomyelitis. He thought that two to four packings in twenty-four hours is the proper number of applications and stated that most packers do not get the packs hot enough. His first visit to the Hubbard tank gave him "indescribable pleasure, relaxation and comfort." He added that "the first dip in the tub and standing on my own two feet for the first time were the two big 'thrills' of my poliomyelitis." He stressed as did so many other of the contributors that "all illness is, of course, both mental and physical" and he thought that group care in poliomyelitis was important. He mentioned that it was his definite impression that "the muscles which have caused the most pain often associated with spasm have the most 'comeback.'" And he concluded, "The goal of all poliomyelitis patients, and my main desire since being sick, is to go where I *need* to go as independently as possible."

The physiatrist will also be interested in Ian Stevenson's observations on severe bronchiectasis. He said, "Withdrawal from physical activity may be harmful to the illness itself. . . . Physical activity to the limit of healthy fatigue was not only possible but highly desirable." Of similar interest is the statement of B. F. Miller, who suffers from weather sensitiveness, that "the new electronic blankets" to be "a true delight to the cold sensitive individual . . ."; also Arthur Rogers' discussion of rheumatoid arthritis in which he points out that good institutional care would "in many cases make the difference between cure or continued illness, mild or severe residual disability, poor or comprehensive rehabilitation." He mentioned that during treatment of his own arthritis "the application of a bewildering variety of physiotherapeutic measures, ranging from paraffin packs to warm pool exercises, began to stretch the adhesions in many of my immobile joints. General and localized heliotherapy, rigidly controlled by a stop watch, stimulated my peripheral circulation and atrophied skin." He observed that, "The application of each new form of treatment caused temporary exacerbations of pain, swelling and the inevitable emotional disturbance which accompanies fear of relapse." With appropriate medical, physical therapeutic and rehabilitative procedures, he has finally achieved a "quiet but satisfying existence" in which he is leading a pleasant social life and also continuing his medical practice.

Any physician who reads this book will be a better physician for having done so. Intelligent colleagues present clearly the psychologic reactions of the patient in the face of illness so that the reader obtains great insight concerning these problems.

PHYSICAL MEDICINE ABSTRACTS

The Value of Intermittent Venous Occlusion: Its Effect of Local Muscle Circulation as Determined by the Clearance of Radioactive Sodium (Sodium 24). E. M. McGirr.

Glasgow M. J. 33:83 (Mar.) 1952.

The immediate effects of intermittent venous occlusion on the circulation have been studied both in human beings and in animals by a multitude of experimental methods. In general it has been found that during venous occlusion the blood flow is impaired; following release of the occluding pressure a transitory increased blood flow may occur, but it does not compensate for the decreased flow during the occlusion. The long term effects of intermittent venous occlusion have not been studied experimentally.

In the present investigation the immediate effects of intermittent venous occlusion on the rate of removal of sodium 24 from the gastrocnemius muscle of human subjects have been studied. The clearance rate of the sodium has been shown by Kety to be a measure of the over-all efficiency of the local circulation. The study showed that during venous occlusion the circulation is impaired. Following release of the occluding pressure a transitory reactive hyperemia occurs. The over-all effect of intermittent venous occlusion is most frequently an impaired circulation. The results obtained do not support the use of intermittent venous occlusion to improve the circulation of an extremity.

Physical and Mental Health in the Aged. Elizabeth C. Horvath, and Steven M. Horvath.

J. Iowa M. Soc. 42:47 (Feb.) 1952.

The superficial aspects of aging — the wrinkles, the gray hair, the shiny dome — are not important. There are more important, even though less conspicuous, changes that occur in aging and bear a greater significance for a happy old age: (1) Retarded repair of tissue; (2) diminished reaction to injury and disease, and (3) diminished reserves and consequently decreased ability to respond to stress. In view of their diminished capacities and reserves should old people exercise? Physical fitness in the aged is important. This state is not the prerogative of the athlete. The aged also may reach a high standard of exercise, physical fitness and health. The aged neither want nor need the physical development of the athlete. They need adequate daily activity of such nature and intensity as to keep the muscles and joints flexible. (This essentially is the aim of physicians and therapists in the field of physical medicine.) Exertion should not be permitted to reach maximal levels but should be stopped before the stage of breathlessness, palpitation or fatigue. The intensity and duration of exercise should be diminished gradually with advancing age. Carefully adjusted exercise is not only permissible but actually beneficial in many cases of degenerative heart disease, a common disorder in the aged. Too often the aged diminish their usual amount of exercise, due from natural disinclination or erroneous advice from relatives. Eventually they take to their beds for good and go downhill more quickly, both in body and mind, than those who remain active. One of the major benefits of exercise is that it serves to divert the mind into fresh channels and gives an emotional outlet for the cares and worries of daily life. The relief of emotional tension in turn acts favorably upon the physical state of the individual. All this is in addition to providing for social outlets and contacts. Most of the restrictions of activity placed upon older people only make the days seem longer by making them duller. Every individual should carry on full activities so long as he can without undue fatigue or other injury to his constitution. He must learn to taper off with advancing age and stay within his limitations.

Ultrasoundwave Treatment of Chronic Disorders of the Locomotor System. Arnold Sonnenschein.

Ann. Rheumat. Dis. 10:441 (Dec.) 1951.

Treatment with ultrasoundwaves is the latest method of physical therapy to attract attention in many countries. Ultrasoundwaves, when properly applied, may diminish pain and reduce irritability of segmental nerve-

endings. They may lessen the spasm of regional muscle-groups. When blood- and lymph-flow mechanically improve, chronic inflammatory products can be removed and the process of healing encouraged. At the same time the fluid content of the tissues and their permeability is increased. Since the therapeutic effect depends largely on mechanical influences, it is obvious that ultrasoundwave therapy is contra-indicated in acute inflammatory conditions, where it would lead to reactivation and exacerbation. One hundred fifty patients suffering from chronic conditions of the locomotor system were submitted to a test of the effectiveness of ultrasound-waves. All had had treatment with various physical methods (mud-packs, diathermy, short-wave diathermy, in some cases x-ray). In most cases, the patients were followed up for a period of one year. Results of this study show that ultrasound treatment is a method which is successful in a number of disorders of the locomotor system which differs in principle from other physical modes of treatment owing to its characteristic mechanical way of action. Since dosage still is inaccurate and many of the effects are still unexplained, much further experimental and clinical work will have to be done before ultrasound can be more widely used in practice.

Observations on the Rehabilitation of the Neurologically Handicapped. Edward B. Schlesinger.

Bull. New York Acad. Med. 28:229 (Apr.) 1952.

The author returned to civilian life after World War II and concluded that the new and highly advertised war born science of rehabilitation was nothing more than good old-fashioned physical medicine with a strong dose of Christian Science thrown in. He emphasizes the fact that the postwar course of rehabilitation has been characterized more by religious fervor than by tongue-in-cheek sober practicality. There is wisdom in informing the public of improved outlook for the chronic disabled and gaining their enthusiastic co-operation. Too often, however, an unclear picture of the ultimate and strict limitations of the handicapped is presented. On too many occasions the public has been led to believe that there is no limit to the possibilities of improvement. The centers are besieged by post-vascular accident hemiplegics and similar cases, each filled with the perseverant concept that normalcy is just around the corner. Schlesinger has searched time and time again for evidence of the new miracles to be offered such patients and come up with the traditionally limited available therapy. The danger here is the disillusionment inherent in the patients being led to expect too much. It is time to subordinate spiritual goals and enthusiasm to more specific medical goals. What is much more important is the impact of the physical rehabilitation program (as opposed to spiritual or emotional) on the crippled patient. In the last few years the author has, as a consultant neurological surgeon, seen and examined an impressive group of patients, all undergoing intensive rehabilitation and all excellent examples of what he calls stress breakdown. Now, every bridge or truck axle has a definite and recognized maximum load. It is a striking fact that similar recognition seldom is given to the human load factor. We glibly talk of ambulation possibilities in the "low dorsal" case, the "mid dorsal" case, etc. How often do we think of the tremendous and unphysiological stress inherent in the gait techniques, we teach these patients? Goading the body on by over-emphasizing the spiritual aspects of rehabilitation tactics and confusing these with purely physical considerations is at the base of many examples of stress breakdown. There are many collaries to this theme. One vivid impression is of seeing instituted long and impressive schedules of rehabilitation for such patients as hemiplegics (of vascular origin), post-operative brain and spinal cord tumors, and so on. With life expectancy short would it not be better to lower the goal and give the patient some time to sit in the sun? Post-vascular accident hemiplegics, particularly, for good reason, perseverate in the idea of return of function and will cooperate to an alarming degree in any scheme of physical exercise ad infinitum, with the blood pressure pounding away at fantastic levels and the cerebral plumbing yielding at the joints. In somewhat similar fashion, but for psychological reasons, patients will replace normal goals with that of physical perfection to a point where it occupies their entire lives. How many of the patients who have laboriously mastered the swing-through gait will be able to continue it into the fourth or fifth decades and at what a price in the rate of structural breakdown? The apparent inverse ratio between vocational success and the continuance of ambulation is amazing. Most successful paraplegics find they are more efficient in a wheelchair and have no time for strenuous exercise. The percentage of patients still using the painfully learned crutch gaits is disappointingly small. The position Schlesinger has taken is based upon a sincere recognition of the importance of many of the entities he has decried—spiritual values, enthusiasm, the excitement of exploration and achievement of new goals. Likewise it does not imply anything but deep respect for the methods and achievements of sound physical medicine. Actually rehabilitation is nothing more than sound follow-through medicine. When the unbraked illusions of the human spirit are allowed to set the goals for the dis-

abled body, fascinating patterns of structural breakdown appear. Many of these we are just beginning to recognize, for the simple reason that we have only recently induced them. To come of age, the science of rehabilitation must include the responsibility of protecting structures on the physical side, and preventing misguided zeal and disillusion on the spiritual.

Importance of Rest in the Treatment of Early Convalescent Poliomyelitis. Wallace Green.

Am. J. Dis. Child. 83:4 (Jan.) 1952.

In the accepted definition of the term, there is no known "cure" for poliomyelitis. During the early convalescent stage when the greatest amount of recovery is taking place, various forms of treatment are being used, the particular modality chosen and championed being a personal choice rather than one scientifically proved to be the most efficacious. There are advocates both for and against pool therapy, electrical stimulation of muscles, drugs, physical therapy, early ambulation, and so forth. Out of this list of treatments must come the realization that none is specific; that as anterior horn cells recover, muscle power spontaneously returns and that a form of therapy must be selected which impedes this natural recovery as little as possible. This paper is based upon personal daily supervision of over 200 patients in the early convalescent stage of poliomyelitis during a recent epidemic and was written to minimize the value of any specific form of active therapy and to emphasize the importance of the unheroic and unglamorous role of rest. The patients were placed upon one of three regimens: (1) unrestricted ambulation and tricycle riding; (2) ambulation and tricycle riding for three one-hour periods daily, and (3) bed rest except for a brief period of physical therapy daily. Groups one and two received the same physical therapy treatment as the third, namely, selective muscle reeducation alternately on a table or in a Hubbard tank and manipulation of each joint through its normal range of motion. Patients in all three groups were maintained in neutral joint alignment when in bed.

Observation showed that the most consistent improvement occurred among patients in the group that was kept at rest except for a brief daily period of supervised muscle reeducation. It was noted that the least amount of improvement, and in many cases regression, occurred among patients in the group allowed unlimited activity. In the latter group it was also noted that patients tended to acquire persistent pathological gaits; smaller children especially, once they had acquired the knack of stabilizing themselves through a pathological gait, would do so too in order to delay fatigue. It was especially difficult, considering the nature of poliomyelitis and its psychological impact upon the patient, the family, the community, the trained and semitrained personnel who were all desperately eager to engage and cooperate in any form of intense active therapy, to insist upon a regimen involving primarily rest. In these days, when fund-raising campaigns for poliomyelitis and general rehabilitation are constantly before the public, to advise rest as the prime treatment lays one open to criticism at the best of lagging behind modern techniques and at the worst, as actually did happen on several occasions, of having a callous disregard for the welfare of unfortunately stricken patients. Skeletal deformities were prevented by maintaining neutral alignment of involved extremities and by putting each joint through its normal range of motion daily. To maintain awareness of muscle action, selective muscle reeducation was carried out for a half-hour period daily. It was to the natural recuperative powers of the anterior horn cells that the greatest credit for increase in muscle power is ascribed. The only method which consistently decreased power in an already paretic muscle, outside of permitting it to be over-stretched by a more powerful antagonist, was to exhaust the muscle through overactivity.

"Glossopharyngeal Breathing," by Paralyzed Patients: A Preliminary Report. Clarence W. Dail.

California Med. 75:217 (Sept.) 1951.

An unusual kind of respiratory action is practiced by several patients at the Rancho Los Amigos who have pronounced poliomyelitic impairment of the respiratory muscles and who, except by this kind of breathing, have a very low vital capacity and limited ability to breathe without artificial means. Very similar to the lung breathing used by most amphibia including frogs and toads, it consists of trapping a small amount of air in the mouth and throat and then forcing it through the larynx by action of the tongue and pharynx and sometimes of the cheeks. The air is then held in the lungs by closure of the larynx while the mouth and pharynx are again filled with air, which again is forced into the lungs. This is repeated about a dozen times until the lungs are quite filled. The air in the lungs is then evacuated, usually through the partly closed lips. This is repeated continuously with a respiratory rate of about six per minute. The terms "glossopharyngeal breathing" and "frog breathing" seem to be quite appropriate for brief description. Several of the patients discovered this method of breathing without help or even suggestion that it was possible. Others learned from them. Several of the patients who

breathe in this manner are able now to be out of the respirator for several hours. Adequate strength of the participating muscles, those of the larynx, pharynx, soft palate, tongue and cheeks and mouth is, of course, necessary. Care should be taken that this method of breathing is not overdone in the presence of inadequacy. There should be no undue fatigue, which may lead to anoxia. To permit time for practice, artificial respiration should be stopped several times daily, for not more than a minute at a time at first but for gradually extended periods as the patient improves in technique. The volume of ventilation per minute should be measured before the patient is able to breathe more than about ten minutes.

Combined Use of Cortisone and Physical Therapy in the Treatment of Arthritic Deformities. William Benham Snow, and James A. Coss.

New York State J. Med. 52:319 (Feb.) 1952.

This report is concerned with patients who have had fairly longstanding arthritis with loss of muscle strength, easy fatigability, apparently irreversible contractures, and deformities. The several cases reported show that physical or medical procedures alone could not help, because the disease activity would not allow intensive exercise. ACTH or cortisone alone were not completely effective, because severe contractures and deformities change very little without the addition of intensive physical measures.

The usual management of these cases has been as follows: A determination of the type and status of the case is made as a result of complete medical work-up. A record is made of present deformities, and the patient is then given either cortisone or ACTH for a test period of about one week. At this point the physiologic effect of the drug has lessened the pain, visibly reduced the inflammatory process and lessened the usual tendency of tissue reaction to activity. This permits the application of vigorous physical therapy even beyond the point of pain. Tight, shortened muscles are passively stretched; casts often are applied to joints showing flexion deformities. After two or three days these casts are bivalved to permit further and continuous forceful passive and active exercise of the joint.

All joints with reduced range of motion are manipulated unless definite ankylosis is present. These manipulations must be carried out with respect and by definitely accepted methods of procedure. It is usually possible to carry out these manipulations with but moderate pain and within the limit of fixed deformity to effect considerable increase in range of movement as a result of the effort.

Following this the patient is instructed in and advised to carry out exercises to maintain the new range of movement which has been established. These exercises are repeated by the patient several times a day. Specially prescribed occupational therapy routines add much to this portion of the program. If there is any increase in pain or any inflammatory sequelae to the manipulation, hot applications and massage are also given.

The patient is placed on ambulant status as soon as possible after the physical therapy is started. Ambulation is enhanced by the use of temporary extension braces which hold the position of increased extension in cases where, with weight bearing inability due to influence of gravity and weak quadriceps, effective walking would be prevented.

Depending upon the degree of postural imbalance and muscular weakness, different aids to walking are utilized. Frequent periods of walking are encouraged. When muscles show weakness because of disuse, they are treated by a strenuous routine of progressively weighted resistive exercises. These exercises strengthen the muscles, and the effort called forth to overcome the weights applied results in further increase in the range of movement.

Physical Treatment in Asthma. James L. Livingstone.

Brit. J. Phys. Med. 15:136 (June) 1952.

In asthma as in other conditions, the earlier treatment is started the better is the outlook. Unfortunately, the majority of cases are treated symptomatically by drugs for months or years before any curative treatment is begun. It does not take many months of mild asthma, or many severe paroxysms, to produce a "conditioned reflex" whereby minor stimuli may provoke an attack: besides the nervous tension and thoracic deformity, the patient loses confidence and develops a dependence on others, particularly his physician, to help him by an injection, an inhaler or some tablet.

It is because of this dependence of the patient that the physical therapist can play such an important part in treatment; she should be able to give the patient the time which is essential for him to acquire confidence, quite apart from giving the physical treatment prescribed. The physical therapist who has the right personality, coupled with enthusiasm and faith in her ability to help her patient, can get results immeasurably better than can one who may have a detailed knowledge of the technique but who lacks these other attributes. As in other disorders of function, the value of suggestion is considerable and should be used. The physical therapist tells the patient that he may (and indeed should) be able to abort a minor attack

of wheezing by breathing exercise alone, without recourse to drugs; he is told to report the first occasion when he is able to do this. This suggestion might be described as "quackery," but in fact some 50 per cent of asthmatic patients so treated do report control of the wheezing within a few weeks. This teaches self-reliance and gives them confidence that there is something they can do for themselves, which is very important. In the training of a physical therapist this principle of "mind over matter" in the treatment of asthma should be stressed.

There is considerable variation in the type of exercises and methods used by different workers, some preferring "assisted exercises," "vibration" and so forth, but the basic principles are the following: (1) To teach the patient to deflate the lungs, to relax the diaphragm, and to breathe with the abdominal and lower thoracic muscles instead of the upper intercostal and accessory muscles, which act on the upper thorax. (2) To increase the mobility of the chest wall, to correct kyphosis, and to prevent further thoracic deformity by teaching relaxation of the overacting muscles of inspiration. (3) To give the patient confidence that he can do something for himself to relieve, at any rate, minor attacks, by relaxing the diaphragm and other muscles, and by doing expiratory exercises which appear to loosen the secretion in the bronchi and relax broncho-spasm.

Over the past twenty years the majority of asthmatic patients under Livingstone's care have been given breathing exercises, and at least 75 per cent have really tried to learn them. Of these at least 60 per cent have, in fact, acquired "controlled" breathing, and most have stated that they regard proper breathing, as being of great value. Perhaps ten per cent of those who have acquired breathing control have failed to improve materially. It is the opinion of Livingstone that an asthmatic patient is not being given the maximum of available benefit if physical treatment is omitted.

Prescription of Physical Therapy in Poliomyelitis. Sedgwick Mead.

J. Missouri M. A. **49**:215 (Mar.) 1952.

There are three main requirements for intelligent physical treatment in poliomyelitis: (1) an understanding of the pathological process and of the physiologic effects of physical agents; (2) competent technical personnel and (3) adequate equipment, which may be modest and frequently improvised. As long as there is any fever or evidence of increasing weakness, one must enforce almost complete bed rest. During this phase the physical therapist carries out passive motions of the trunk and all extremities through a complete range of motion. Using care to prevent sagging or undue tension on tender parts, she does each movement at least ten times and preferably repeats each visit twice daily. The most important motions are trunk flexions, knee flexion, hip flexion with the knee extended, plantar flexion, hip internal rotation and shoulder abduction and rotation. Some deformities result from neglect and ignorance, but certain types cannot be prevented by the most faithful treatment. The acute stage may be considered over when the patient is out of isolation. Again the objectives are to get rid of residual muscle shortening reactions and discomfort, to continue muscle reeducation and to begin resistance exercise in order to restore strength. Walking is permissible if body strength permits and deforming stresses can be avoided. Residual tightening can be treated by whirlpool or Hubbard tank treatments followed by fractional stretching. Incoordination and substitutions are vigorously combatted. In the intermediate phase one often uses an interrupted schedule, building the basic treatment around progressive resistance exercises. As is true of many other diseases, increasing complexity of procedures and equipment may result in care of selected patients in this phase at special centers, whereas early treatment often can be properly done in the small hospital and by the average practitioner, internist or pediatrician. One should prescribe progressive resistance exercises from four to six times weekly until no further gains are noted. The ten resistance maxima or assistance minima give a quantitative measure of improvement in each muscle or muscle group. At the conclusion of such a bout of exercise one usually gives the patient a three to four months' vacation but makes such checks as are necessary on scoliosis, foot mechanics, brace fits and such. Whenever possible, home treatment by means of progressive resistance exercise should be used, but the level of achievement should be checked at weekly visits. Progressive resistance exercise is invaluable in helping the patient to gain realistic insight into his limitations and the permanence of disability. When two or three bouts of exercise fail to budge the functional level of a muscle, the patient is convinced. Intensive physical therapy after the twelfth month is usually unnecessary unless early treatment has been utterly neglected. The worst abuses of physical therapy in poliomyelitis consist of useless treatment and overtreatment. The most common abuse is failure to define goals and prescribe precisely. This article gives as examples a prescription of a hypothetical case for each phase of the disease.

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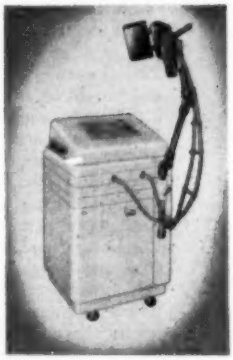

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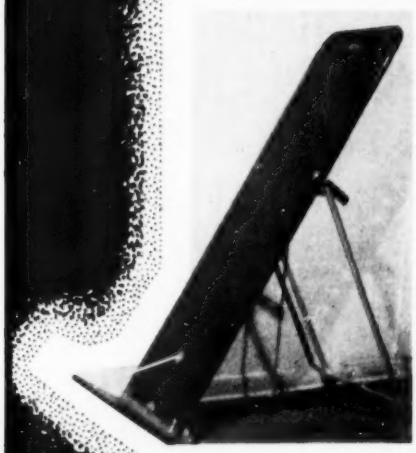

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Name and Location of School	Director and Medical Director	Entrance Requirements	Duration of Course[1]	Classes Begin	Tuition per Year	Certificate, Diploma, Degree
University of Southern California, Los Angeles*	Margaret S. Rood	Degree	18 mos.	Varies	$594	Certificate
	J. B. Armstrong, M.D.	High sch.	5 yrs.	Varies	$540	Cert. & Deg.
Mills College, Oakland, Calif.	Elsa H. Hill	Degree	2½ yrs.	FebSept	$250	Certificate
		High sch.	4 yrs.	FebSept	$650	Cert. & Deg.
San Jose State College, San Jose, Calif.*	Mary D. Booth	Degree	18 mos.	Varies	$ 28.50	Certificate
	Charles Ianne, M.D.	High sch.	45 mos.	Varies	$ 28.50	Cert. & Deg.
Colorado Agricultural and Mechanical College, Fort Collins, Colo.*	Marjorie Ball	Degree	2 yrs.	Varies	$147[2]	Certificate
	W. R. Conte, M.D.	High sch.	5 yrs.	Varies	$181[2]	Cert. & Deg.
University of Illinois College of Medicine, Chicago*	Beatrice D. Wade	High sch.	5 yrs.	MarSept	$110	Degree
	S. W. Olson, M.D.	———	———	———	———	———
State University of Iowa, Iowa City*	Elizabeth Huntsberry	———	19 mos.	FebSept	$ 75[2]	Certificate
	W. M. Fowler, M.D.	High sch.	46 mos.	FebSept	$ 75[2]	Cert. & Deg
University of Kansas, Lawrence	Nancie B. Greenman	High sch.	45 mos.	FebSept	$110[2]	Degree
	D. L. Rose, M.D.	———	———	———	———	———
Boston School of Occupational Therapy, 7 Harcourt St., Boston*	Marjorie B. Greene	Degree	2 yrs.	Sept	$500	Certificate
	A. W. Reggio, M.D.	High sch.	5 yrs.	Sept	$500	Degree
Wayne University, Detroit*	Barbara Jewett	Degree	19 mos.	Varies	$150	Certificate
	F. A. Weiser, M.D.	High sch.	46 mos.	Varies	$150	Degree
Kalamazoo School of Occupational Therapy, Kalamazoo, Mich.*	Marion R. Spear	Degree	18 mos.	FebSept	$ 75[2]	Certificate
	Donald May, M.D.	1 yr. coll.	4 yrs.	FebSept	$ 75[2]	Cert. & Deg.
Michigan State Normal College, Ypsilanti, Mich.*	Frances Herrick	High sch.	5 yrs.	Sept	$140[2]	Cert. & Deg
	J. W. Rae, Jr., M.D.	———	———	———	———	———
University of Minnesota, Minneapolis*	Borghild Hansen	High sch.	40 mos.	Sept	$149.55	Degree
	F. J. Kottke, M.D.	———	———	———	———	———
College of St. Catherine, 2004 Randolph Ave., St. Paul	Sister Jeanne Marie	Degree	16 mos.	Varies	$240	Degree
	J. M. Ryan, M.D.	High sch.	5 yrs.	Varies	$240	Degree
Washington University School of Medicine, St. Louis*	Erna L. Rozmarynowski	Degree	19 mos.	Sept	{ Univer-	Certificate
	R. A. Moore, M.D.	2 yrs. coll.	28 mos.	Sept	{ sity	Degree
University of New Hampshire, Durham*	Esther Drew	High sch.	5 yrs.	Sept	$250[2]	Cert. & Deg.
	J. A. MacDonald, M.D.	———	———	———	———	———
Columbia University College of Physicians and Surgeons, New York City*	Marie L. Franciscus	Degree	17 mos.	Sept	$600	Certificate
	W. B. Snow, M.D.	2 yrs. coll.	27 mos.	Sept	$600	Degree
New York University School of Education, New York City*	Frieda J. Behlen	1 yr. coll.	———	FebSept	{ Univer-	Certificate
	John Sawhill, M.D.	High sch.	4½ yrs.	FebSept	{ sity	Cert. & Deg.
Ohio State University, Columbus*	Barbara Locher	High sch.	4 yrs.	Varies	University	Degree
	R. E. Worden, M.D.	———	———	———	———	———
Philadelphia School of Occupational Therapy of the School of Auxiliary Medical Services of the University of Pennsylvania, Philadelphia*	Helen S. Willard	Degree	18 mos.	Sept	$600	Certificate
	J. C. Yaskin, M.D.	High sch.	5 yrs.	Sept	$600	Cert. & Deg.
Texas State College for Women, Denton	Fanny B. Vanderkooi	Degree	18 mos.	FebSept	———	Certificate
	O. T. Woods, M.D.	High sch.	5 yrs.	FebSept	$ 50[2]	Degree
Richmond Professional Institute, 901 W. Franklin St., Richmond, Va.*	H. Elizabeth Messick	Degree	10-18 mos.	FebSept	$182+	Certificate
	J. E. Barrett, M.D.	High sch.	5 yrs.	Sept	$200	Degree
College of Puget Sound, N. 15th and Warner Sts., Tacoma, Wash.*	Edna-Ellen Bell	1-4 yrs. coll.	2-3 yrs.	Jan-Sept	$350	Certificate
	T. H. Duerfeldt, M.D.	High sch.	5 yrs.	Jan-Sept	$350	Cert. & Deg.
University of Wisconsin, Madison*	Caroline G. Thompson	High sch.	5 yrs.	Sept	$150[2]	Cert. & Deg.
	H. D. Bouman, M.D.	———	———	———	———	———
Milwaukee-Downer College, Dept. of Occupational Therapy, 2512 E. Hartford Ave., Milwaukee	Henrietta W. McNary	2 yrs. coll.	3 yrs.	Sept	$350	Certificate
	M. C. Borman, M.D.	High sch.	5 yrs.	Sept	$350	Degree
Mount Mary College, 92d and Burleigh, Milwaukee	Sister Mary Arthur	High sch.	5 yrs.	Sept	$310	Cert. & Deg.
	J. C. Griffith, M.D.	———	———	———	———	———

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1. Duration of course is expressed in academic years or in number of months.

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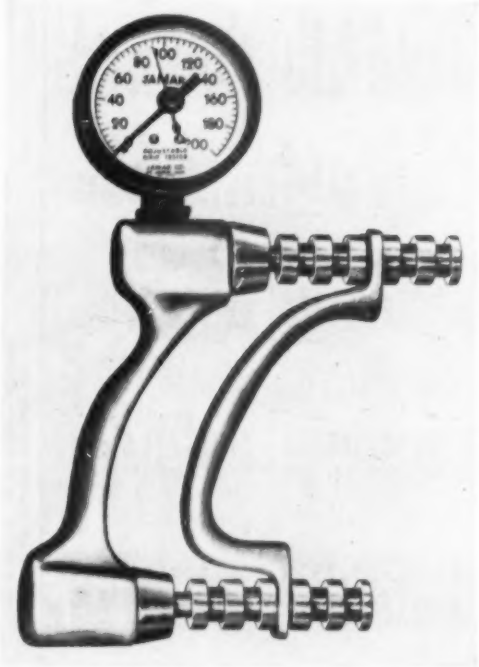

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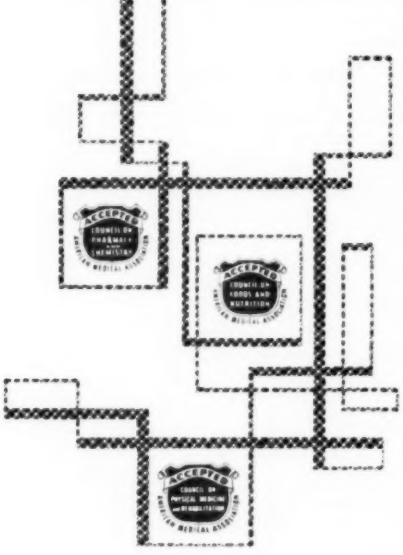

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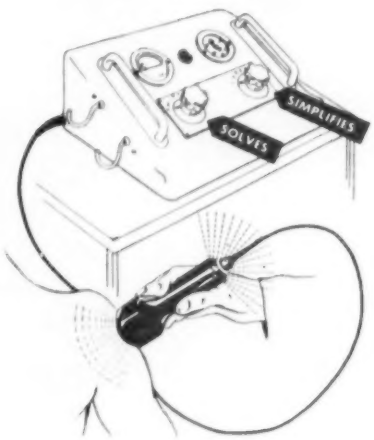

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American Congress of Physical Medicine and Rehabilitation — 31st Annual Session, The Palmer House, Chicago, August 31 through September 4, 1953. Walter J. Zeiter, M.D., Chairman, Convention Committee, 30 North Michigan Ave., Chicago 2.

Chicago Society of Physical Medicine and Rehabilitation — Regular monthly meetings, September through May, every fourth Wednesday. Dr. I. F. Hummon, Secretary-Treasurer, 30 N. Michigan Ave., Room 1429, Chicago.

New York Society of Physical Medicine — Monthly meetings held first Wednesday. Madge C. L. McGuinness, M.D., Secretary, 48 E. 62nd St., New York 21, N. Y.

Pennsylvania Academy of Physical Medicine and Rehabilitation—Regular meetings on third Thursday of month, held bi-monthly. Secretary, Charles A. Furey, M.D., 2201 St. James St., Philadelphia 3, Pa.

American Occupational Therapy Association —Annual Conference, November 13-20, 1953, Shamrock Hotel, Houston, Texas. Marjorie Fish, OTR, Executive Director, 33 West 42nd Street, New York 18, N. Y.

American Physical Therapy Association — Annual Conference, June 15-19, Baker Hotel, Dallas, Texas. Mildred Elson, Executive Director, 1790 Broadway, New York 19, N. Y.

International

World Congress of the World Confederation for Physical Therapy—London, England, September 7-12, 1953. Secretary, Miss M. J. Neilson, Chartered Society of Physiotherapy, Tavistock House, South, Tavistock Square, London, W.C. 1, England.

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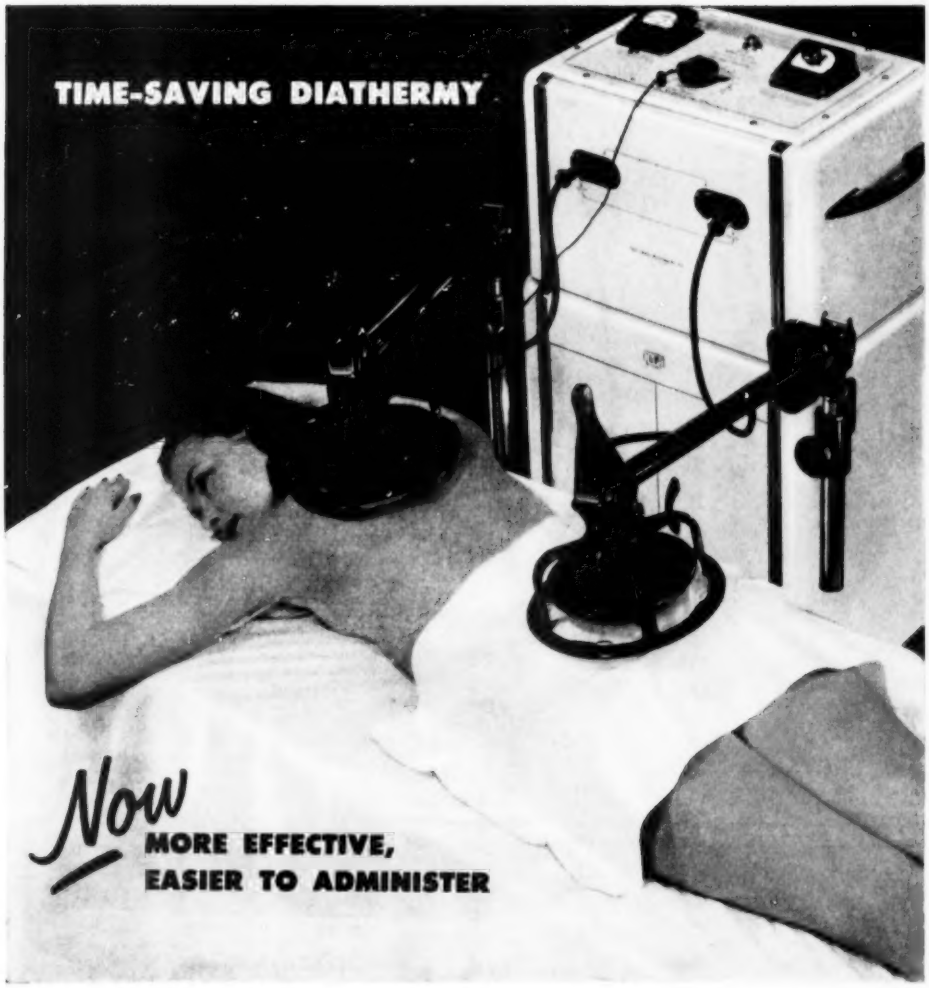

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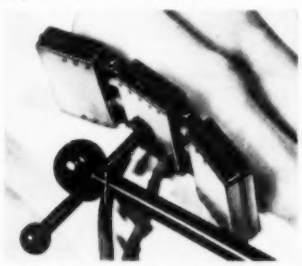

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